1377

NICOLET
SCIENTIFIC
CORPORATION

AN INTRODUCTION
TO
THE MODEL 100A MINI-ANALYZER

NICOLET SCIENTIFIC CORPORATION

245 LIVINGSTON STREET, NORTHVALE, NEW JERSEY 07647

Seagate Technology

NICOLET SCIENTIFIC CORPORATION

AN INTRODUCTION

TO

THE MODEL 100A MINI-ANALYZER

NICOLET SCIENTIFIC CORPORATION / 245 LIVINGSTON ST., NORTHVALE, N. J. 07647 USA
TELEPHONE (201) 767-7100, TELEX 6853154, TWX 710-991-9619

WARRANTY

All Nicolet Scientific instruments are warranted against defective materials and workmanship for one year. For detailed information on the warranty agreement, refer to the page at the rear of this publication for conditions and shipping instructions.

**Copyright © 1981 by Nicolet Scientific Corporation.
All Rights Reserved.**

Printed in the United States of America. All rights reserved. Contents of this publication may not be reproduced in any form without permission of the copyright owner.

PROPRIETARY NOTICE

This information is furnished only for test and maintenance purposes. The data is proprietary in nature and should be treated accordingly. The data shall not be either released or used, duplicated, or disclosed in whole or in part for manufacture or procurement without the written permission of Nicolet Scientific Corporation, except for (i) emergency, repair or overhaul work by or for the government, where the item or process concerned is not otherwise reasonably available to enable timely performance of work; or (ii) release to a foreign government, as the interests of the United States may require; provided that in either case the release, use, duplication or disclosure hereof shall be subject to the foregoing limitations. This legend will be marked on any reproduction hereof in whole or in part.

NICOLET
SCIENTIFIC
CORPORATION
A NICOLET INSTRUMENT SUBSIDIARY

Dear Customer:

I would like to thank you personally for having selected Nicolet Scientific Corporation equipment for your application. Most instruments that we produce are burned-in and subjected to vibration and temperature tests before shipment, to maximize the equipment's reliability.

If, however, your equipment should not operate properly upon receipt, check your interconnections and control settings against the information supplied in this instruction manual. Should you find that the equipment fails to operate as specified, call us. We will either provide service information via phone conversation or we will authorize your return of the equipment for factory servicing, if required.

May I ask your cooperation in completing the enclosed, prepaid postcards? The information which we request will permit us to serve you better in the future. We would like to know to whom to address any Instruction Manual revisions, field modifications, suggestions, or new application literature.

Thank you again for purchasing our equipment. We look forward to serving you again in the future.

Sincerely,

Reinhold Vogel

Reinhold Vogel
President

245 Livingston Street
Northvale, New Jersey 07647, USA
(201) 767-7100 / TWX: 710 991 9619
TELEX: 6853154

TABLE OF CONTENTS

SECTION	TITLE	PAGE
1	INTRODUCTION TO THE 100A	1-1
	General Description	-1
	Turning on the Unit	-1
	Frequency Range	-2
	Data Display	-3
	Input Sensitivity	-3
	Vertical Scale	-5
	Measure	-6
	Instant Zoom	-11
	Data Memory	-15
	Panel Store	-18
	Weighting	-19
	Averaging in Frequency Domain	-21
	Averaging in Time	-23
	Average Zoom	-25
	Trigger	-27
	Tracking	-28
	ICP Signal Input	-29
2	SPECIFICATIONS	2-1
	Input	2-1
	Analysis	-1
	Averaging	-2
	Storage	-2
	Display	-3
	Display Annotation	-3
	Calibration	-4
	Cursor Measurements	-4
	Transient Capture	-4
	Triggering	-5
	Tracking	-5
	Physical	-5
3	SCHEMATIC DIAGRAMS	
	Schematic Diagram Disclaimer	3-1
	WARRANTY	

INSTRUCTION MANUAL NOTICE

Every effort has been made by the Engineering and Service Departments of Nicolet Scientific Corporation to present accurate, helpful, and readily understood instructions in this manual. Our goal is to assist you in the efficient operation and maintenance of your precision instrument. The following information will facilitate your use of this publication.

CORRECTIONS:

Sometimes, changes in text or descriptions of circuit design changes cannot be incorporated in the printed manual (and its schematic diagrams). In this event, we provide you with the latest data on the colored pages in this manual following this page. These colored pages cover corrections to the text or to certain of the schematic diagrams, and must be read for the manual to properly reflect the equipment you received.

DATA COVERING OPTIONAL FEATURES AND SYSTEM CONFIGURATIONS:

Data covering certain optional features of our equipment, or special system configurations are provided in the text. If you have not ordered these options, the corresponding section of the manual does not apply to the equipment you received.

SPECIAL INSTRUCTIONS

W A R N I N G

CONCERNING SAFE OPERATION OF ELECTRICAL EQUIPMENT:

1. This equipment is supplied with a detachable, rubber-covered electrical ac power line cord. One termination of the cord is a standard three-contact female connector for mating the AC INPUT receptacle on the instrument rear panel. The other termination is a three-prong male connector for mating a power source outlet, with one of the power source terminals at ground potential.

   THIS EQUIPMENT SHOULD NEVER BE OPERATED UNLESS PROPERLY GROUNDED.

2. If you use a two-prong to three-prong adapter for mating to your power source outlet, make sure that the pigtail lead (the grounding strap which is provided on the two-prong adapter) is securely grounded.

   FAILURE TO FOLLOW THIS WARNING MAY RESULT IN ELECTRICAL SHOCK TO OPERATING AND MAINTENANCE PERSONNEL.

3. Nominal 115-volt or 220-volt ac potentials are present on the terminals of the front panel POWER switch and on the rear panel ac POWER INPUT connector and line protective fuse. Nominal 115-volt or 220-volt ac potentials also exist on the terminal strip of the self-contained power supply module and at various electrical terminals within the power supply module.

   ALWAYS EXERCISE EXTREME CARE WHEN WORKING IN OR NEAR THESE AREAS TO AVOID SEVERE ELECTRICAL SHOCK!

4. Lethal dc voltages are present within all Nicolet Scientific Corporation manufactured equipment utilizing switching type power supplies and CRT displays. This equipment should only be serviced by TRAINED PERSONNEL using extreme care to avoid severe electrical shock.

WARNING NOTICE

W A R N I N G N O T I C E

This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instructions manual, may cause interference to radio communications. As temporarily permitted by regulation it has not been tested for compliance with the limits for Class A computing devices pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference. Operation of this equipment in a residential area is likely to cause interference in which case the user at his own expense will be required to take whatever measures may be required to correct the interference.

W A R N I N G N O T I C E

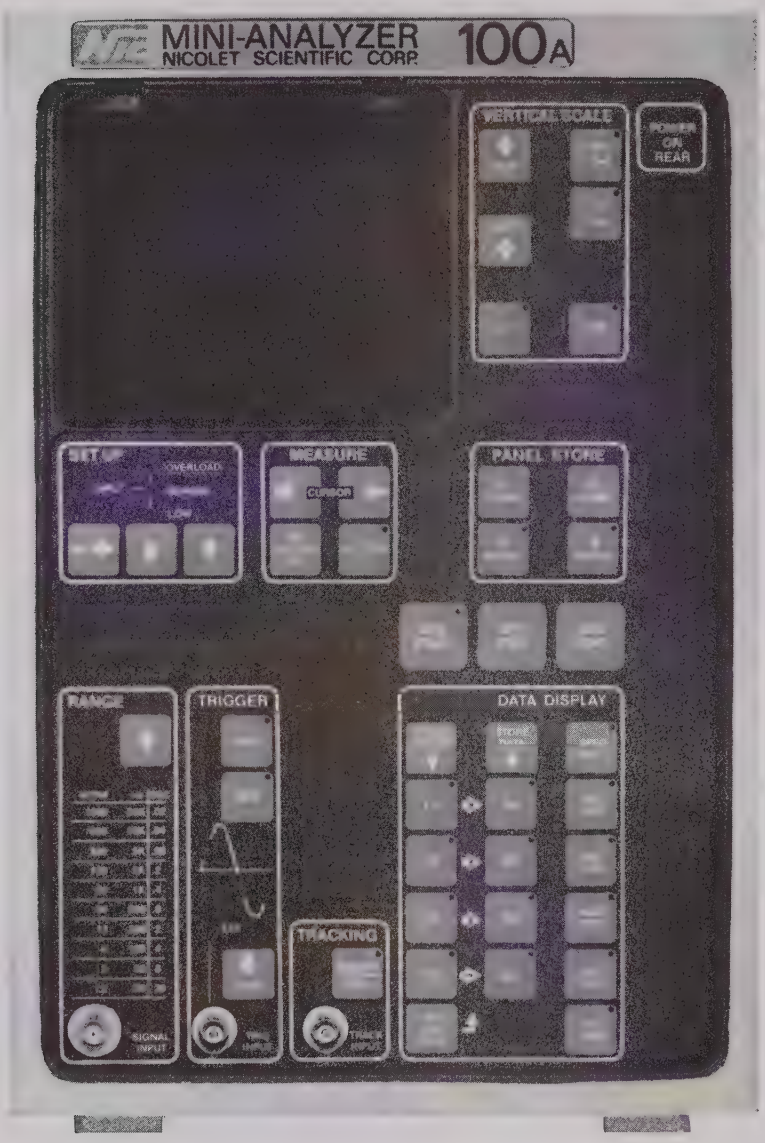


FIGURE 1-0. Nicolet 100A Mini-Analyzer Front Panel.

INTRODUCTION TO THE NICOLET 100A

Congratulations! You now own a Nicolet 100A Mini-Analyzer. We are confident that you will find the 100A to be powerful, portable, and very simple to use.

The purpose of these pages is to introduce you to the 100A front panel and display. We hope to make you comfortable with the front panel and familiar with the display with a minimum of effort.

Let's plunge right in...

General Description:

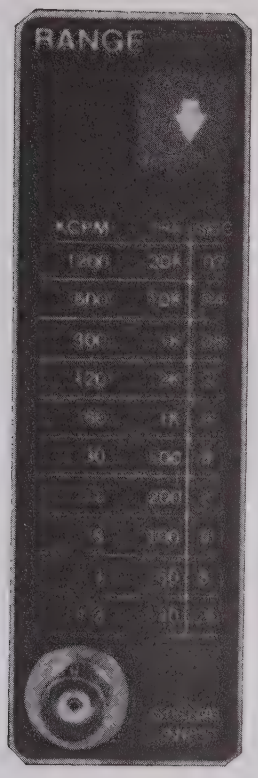
The Nicolet 100A is a single channel spectrum analyzer. It uses raster scan display (like a TV, not vector graphics as in previous Nicolet Scientific Corporation (NSC) products) and it can display one or two traces. The two traces may be any functions of the one input, a function and a memory, or two memories. Maximum frequency range = 20 KHz.

Turning the Unit On:

The on/off switch is on the back of the unit. The POWER ON REAR button, is the system reset button. If pressed, or on initial power-up, the LCA comes up in this state: frequency range = 20 KHz; dual display; function = INSTant TIME and INST SPEC; input sensitivity = 2 V; display gain = 1 on the top display and a 60 dB wide log display on the bottom. Each of these settings will be explained. When the LCA is on, the green LED in the POWER ON REAR button should be lit.

The LCA remembers its current state in the battery protected CMOS RAM when it is turned off. It comes up in the same state as when it was turned off. The only time the LCA comes up in the reset state is when the CMOS State Table fails the sum check test which is done before recalling it. The reset state may also be obtained by pressing POWER ON REAR (reset).

Frequency Range:

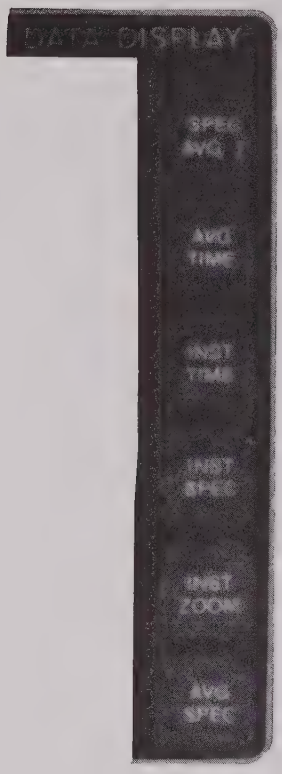


One LED should be on in this section, showing the current frequency range. Pushing the down arrow selects the next lower frequency range.

To the left of each LED is full scale frequency in kilocycles per minute (KCPM). To the right of each LED is full scale frequency in cycles per second and then full scale time (time to collect 1024 points) in seconds (SEC).

Data Display:

The rightmost column of buttons in the DATA DISPLAY section is made up of the six function buttons. The functions are:



SPECtrum of AVeraGe Time - FFT of contents of averager buffers.*1

AVeraGe TIME - Contents of averager buffers displayed as time.*1

INSTant TIME - The input time signal.

INSTant SPECtrum - FFT of the input time signal (1024 time points).

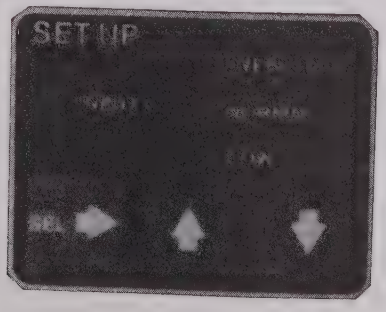
INSTant ZOOM - FFT on 10240 time points, gives 4000 points in frequency domain, any 400 of which can be viewed at once.

AVeraGe SPECtrum - Contents of the averager buffers viewed as frequency (RMS SPEC).*2

*1 = Valid only after averaging time.
*2 = Valid only after averaging frequency - sum, exponential, or peak.

Pressing a function button once makes the function appear on the display and turns on the LED. Pressing the button a second time removes this function from the display. If two functions are displayed, and another function is desired, one of the displayed functions must be turned off so that the new function can be added to the display.

Input Sensitivity:



This setting specifies the voltage that is full scale output of the A to D converter, that is, it controls the attenuator. Note that here is no knob marked INPUT SENS or ATTEN. Input sensitivity is one of the items controlled by the SET UP buttons. It is annotated on the bottom of the display along with other current status information. Below a picture of the display is shown.

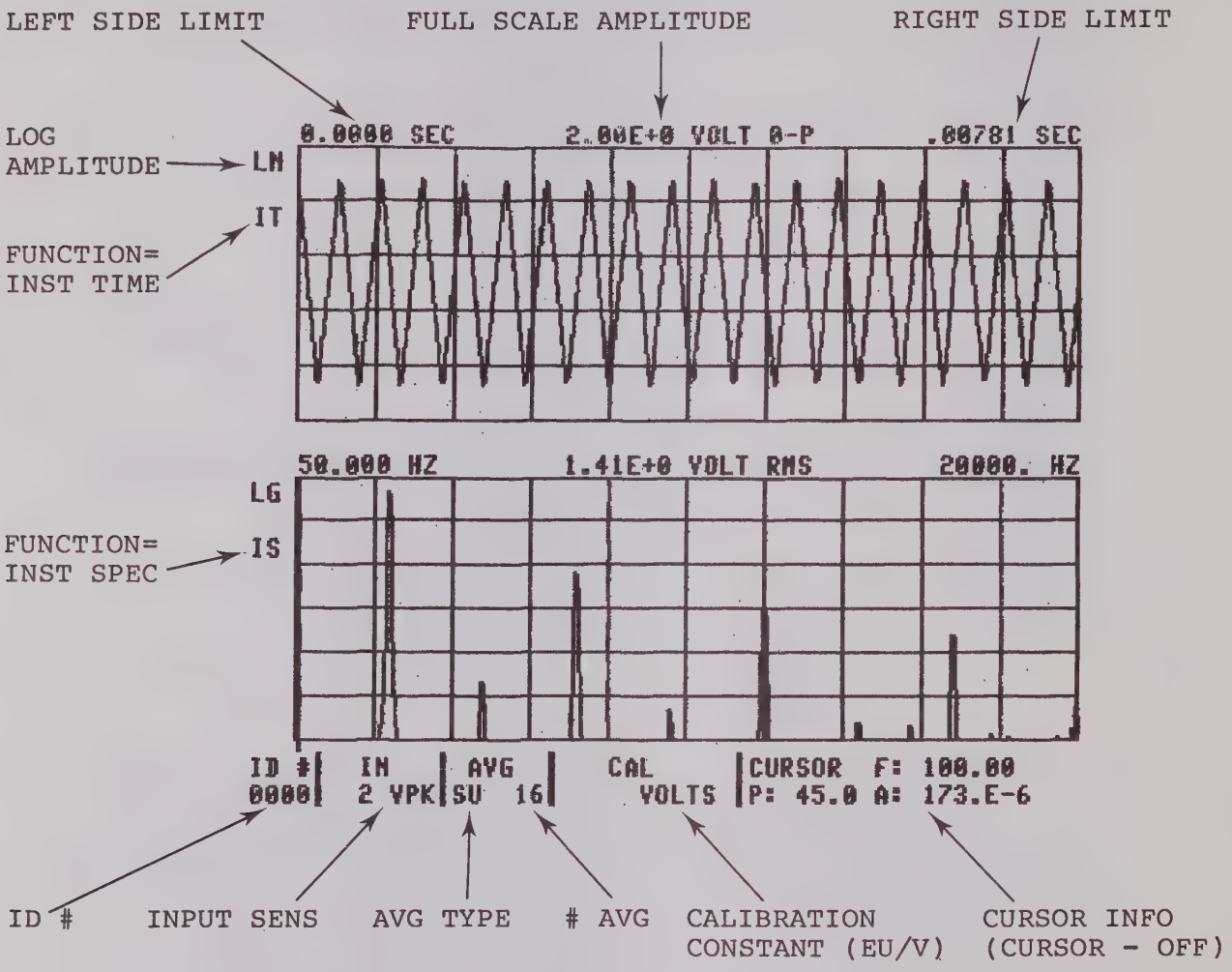


FIGURE 1-1

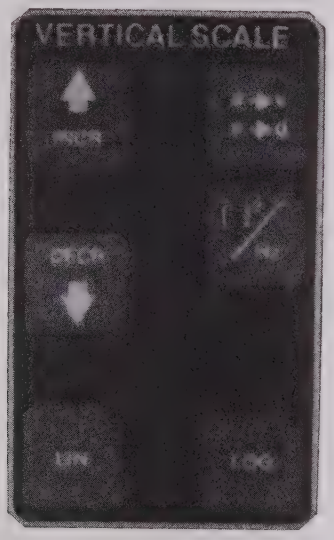
Pushing SELect once causes the first digit of the ID # to appear in inverse video. Pressing either the up or down arrows changes this digit. Pressing the SELect button again moves the inverse field to the second ID # digit, as in: ID# 0000. Now the up and down arrows change this digit. Similarly, pressing select three more times causes the input sensitivity to be in inverse video and the up and down arrows can be used

to change the setting. Via the SELect keys and only via the SELect keys, can the attenuator (input sensitivity), the type of average, the number of averages, type of weighting (Hanning or flat), the calibration constant, and the ID # be set. The ID # is only used to identify pictures.

The input sensitivity should be set so that the green NORMAL LED is illuminated. This indicates that the input signal is within 24 dB of full scale. If the input signal falls below this level, the yellow LOW LED will illuminate. The red OVERLOAD LED indicates that the input signal is too large to be accurately represented by the analog to digital converter and is greater than full scale.

If more than one input setting LED lights, only the NORMAL LED, the lower sensitivity should be used to maximize dynamic range.

Vertical Scale:



INCRement increases the display gain (makes the data look larger); DECRement decreases the display gain. If two displays are being viewed, INCR and DECR effect the display with the cursor.

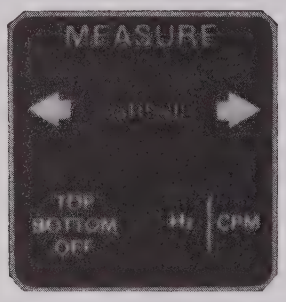
LIN and LOG specify linear or logarithmic amplitude display.

LOG displays are usually used for spectra and LIN for time. The default LOG display is 60 dB wide. Pressing INCR increases the "width" to 120 dB, causing the data to appear to compress upward in the display.

a→v, v→d is single integration on/off (acceleration goes to velocity, or velocity goes to displacement). This effects functions of frequency only.

$()^2$/Hz is PSD (Power Spectral Density). PSD calculates magnitude squared (in whatever units after integration and CAL constant are applied) divided by β (cell width in Hz). Weighting is corrected for, if it is being applied. PSD calculation is done before conversion to dB when units are dB and before scaling for RMS or peak to peak (x0.7071 or x2, respectively).

Measure:



The first button to press in this group is TOP/BOTTOM/OFF, which turns on the cursor. If there is only one display, pressing it again turns off the cursor. The cursor left and right arrows move the cursor. If one of these buttons is held, the cursor will slew. A single display with the cursor appears as:

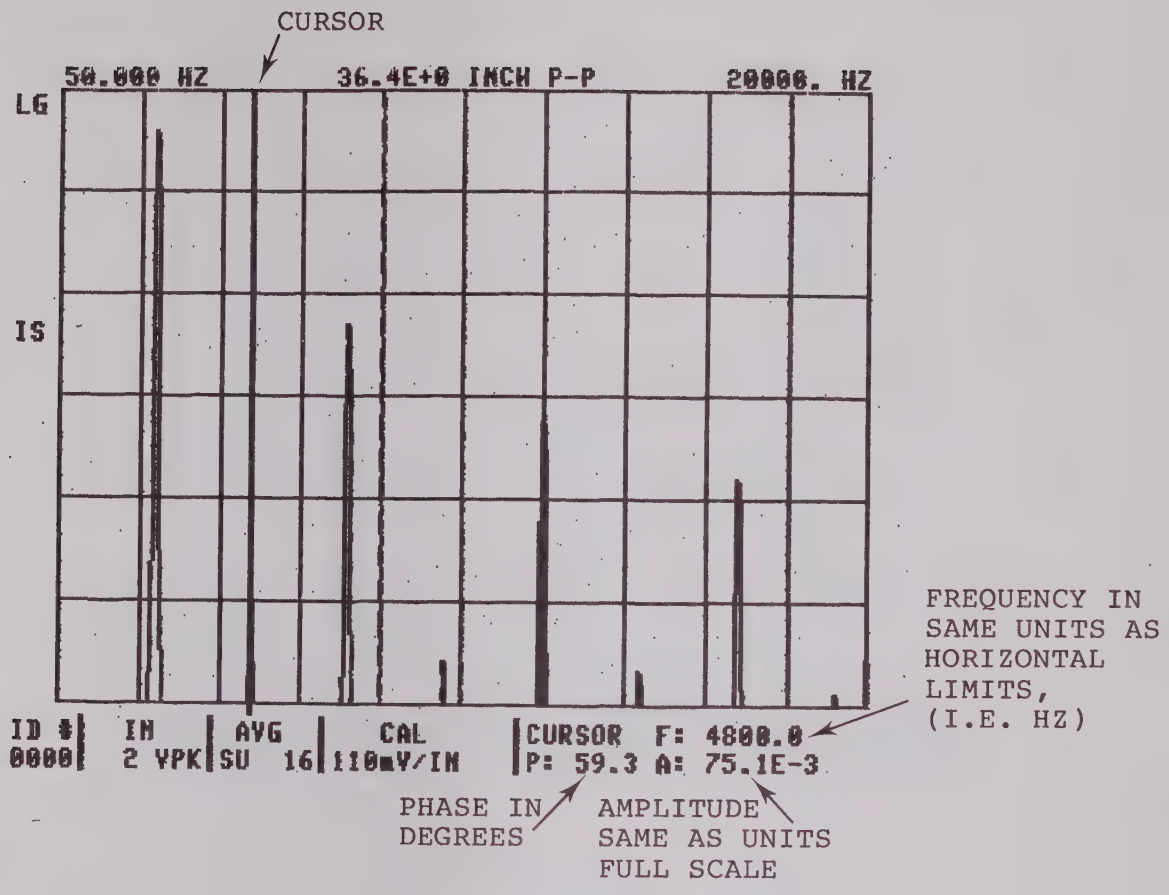


FIGURE 1-2

NOTE:

Now that the cursor is on, store cursor locations by pressing STORE CURSOR followed by one of the buttons below it labeled: C1, C2, C3, or C4. To recall a stored cursor location, just press one of the buttons C1 to C4. The previous position of the cursor is lost.

The Hz/CPM button, when pressed once, causes the horizontal position to be annotated in cycles per minute instead of Hz, which makes the display appear as:

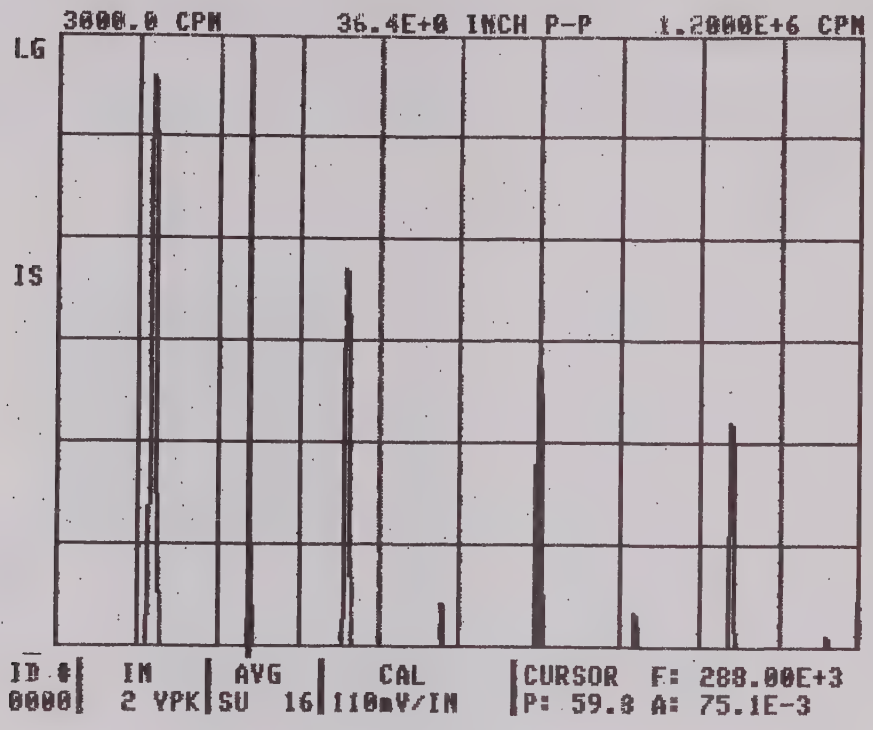


FIGURE 1-3

For time displays, the horizontal position will be in either seconds or minutes.

In ORDERS (external sampling clock), Hz/CPM shifts between cell number and %FS (% Full Scale). Time functions consider cell 1024 to be full scale.

Next, pressing the INST TIME button places the second function (instant time) on the display. The display appears as:

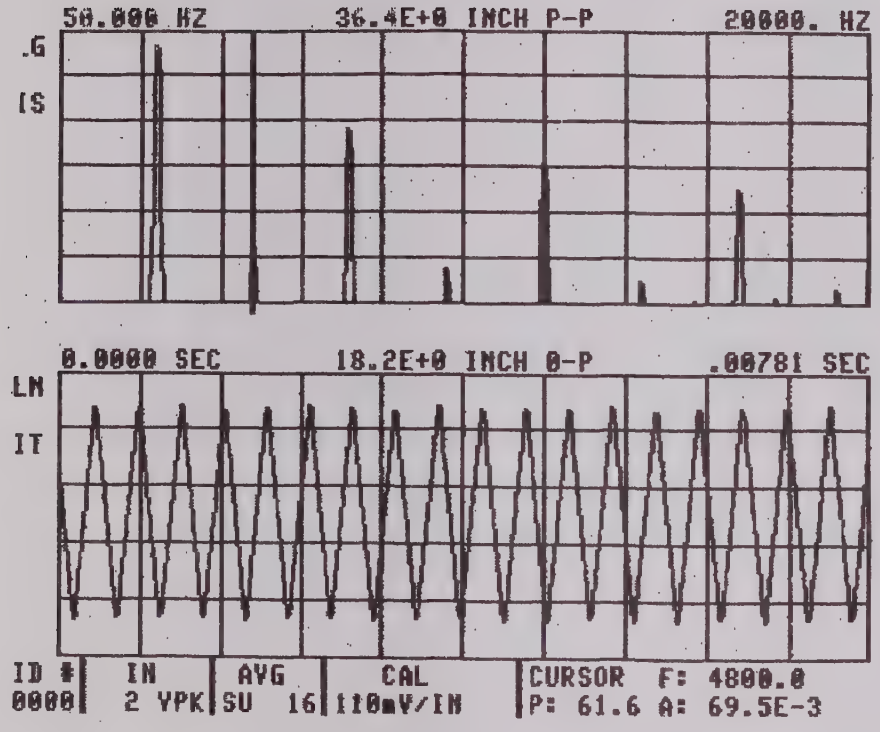


FIGURE 1-4

* The cursor is still on INST SPEC in the top display.

* The horizontal limits of the lower display are in seconds.

If the TOP/BOTTOM/OFF is pressed, the cursor will drop down to the bottom of the display:

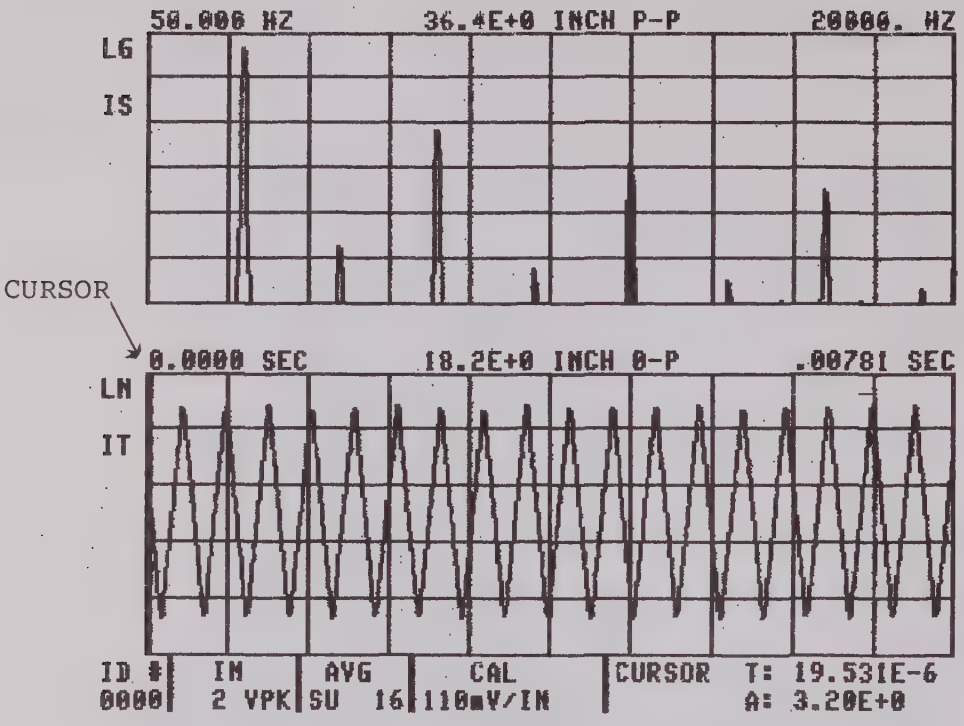


FIGURE 1-5

* The cursor appears on cell 1. There are three separate cursors: frequency, time, and 10K time. Moving the cursor on a frequency display does not affect its position on a time display.

* The cursor information is now time and amplitude, not frequency and amplitude. (Phase is only displayed on INST SPEC, INST ZOOM, and SPEC of AVG Time.)

* Once again, the cursor horizontal position is in the same units as the horizontal limits of the display (seconds), and amplitude is in the same units as the full scale annotation (inches, zero to peak).

* The first 400 of 1024 samples are visible on the INSTant TIME display as shown. By moving the cursor to the right, any 400 samples may be displayed. This works similarly to the 100A INSTant ZOOM display which is discussed next.

Instant Zoom:

INSTant ZOOM is a unique function, providing ten times the frequency resolution of instant or averaged spectrum.

First, consider the instant spectrum and instant zoom display shown below.

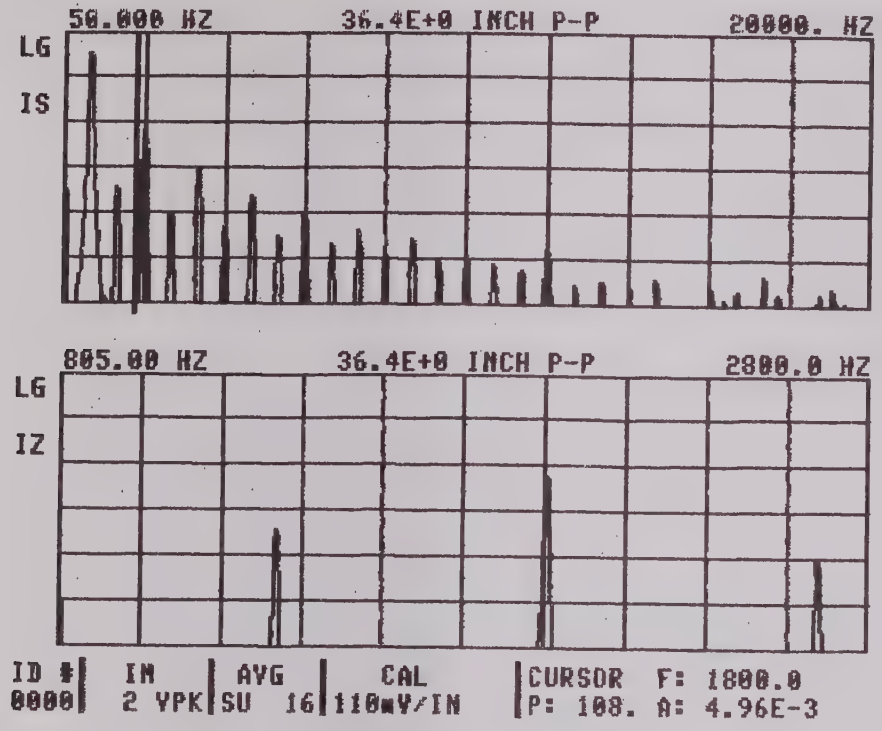


FIGURE 1-6

Looking at the horizontal limits of both displays, note that:

1. The top display is INSTant SPEC (20 KHz range); the bottom display shows one tenth of the top display (a 2 KHz slice) blown up to full scale.

2. The INSTant ZOOM is a x10 expansion of the baseband spectrum centered at the cursor frequency.

If the cursor is moved on the INSTant SPEC (baseband) display, the limits of the zoom display change to follow. Data will appear to move across the instant zoom display as the cursor moves.

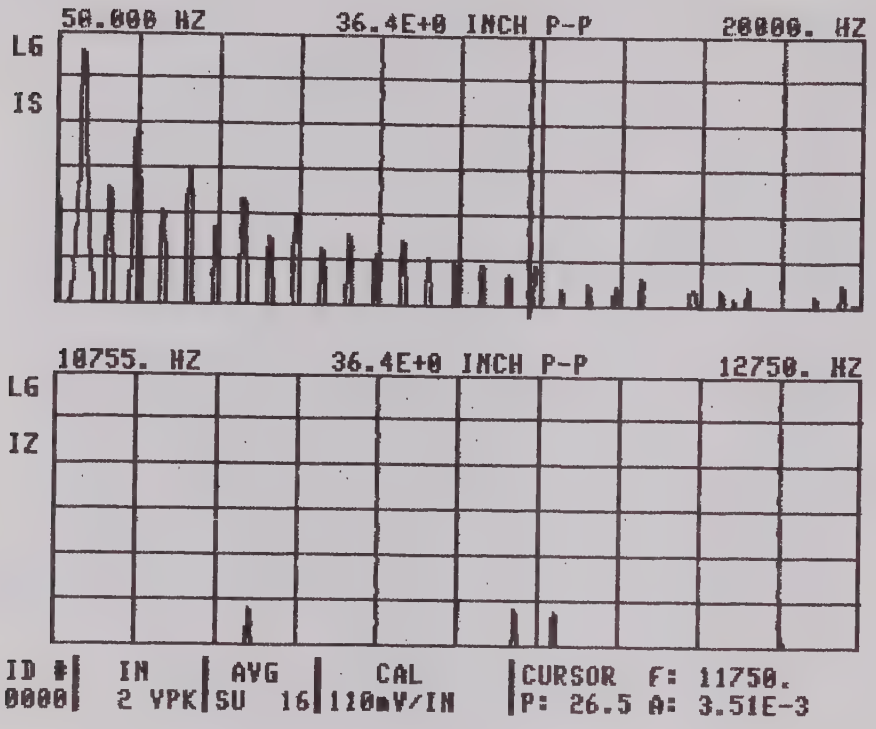


FIGURE 1-7

NOTE: What appears to be a single peak just to the right of the cursor on the INSTant SPEC display is clearly two peaks when seen on the INSTant ZOOM display.

If INSTant SPEC is pressed, the display of that function disappears leaving instant zoom as the only display. The cursor will still be on. Since an instant zoom display is centered at the cursor frequency, the cursor (almost) always will be in the center of the display. Pressing CURSOR left or right causes the data to slide by, behind the cursor as the horizontal limits change. The display appears as:

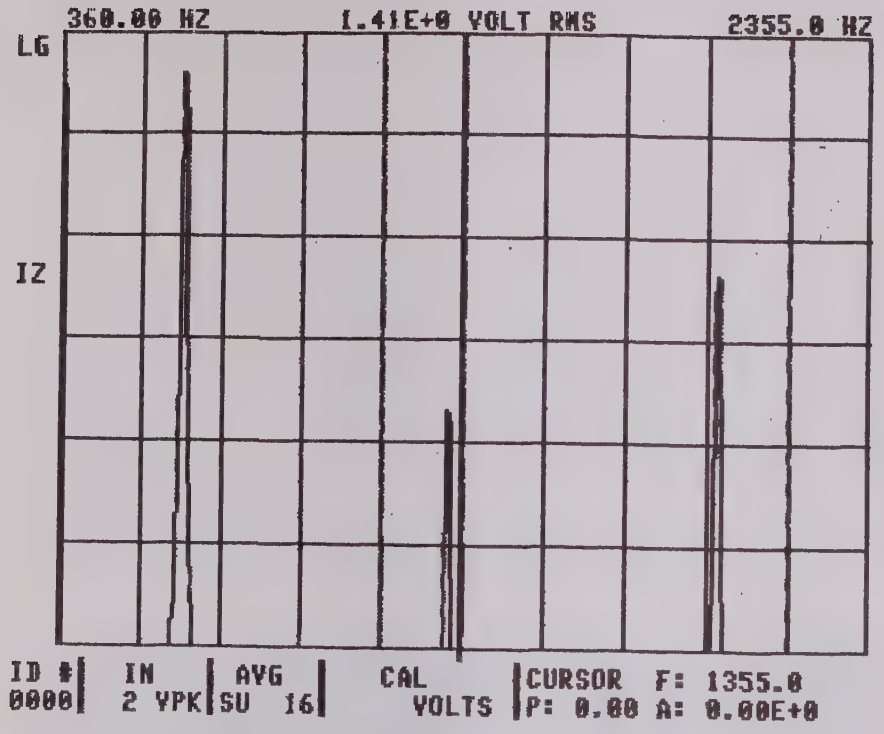


FIGURE 1-8

Previously, it was noted that the instant zoom displays are <u>almost</u> always centered at the cursor. The exceptions are when the cursor frequency is very low (near DC) or very high (near full scale). Since DC or below can not be shown, or above full scale frequency can not be shown, the data stops moving; and, the cursor moves off the center of the display. Two examples are:

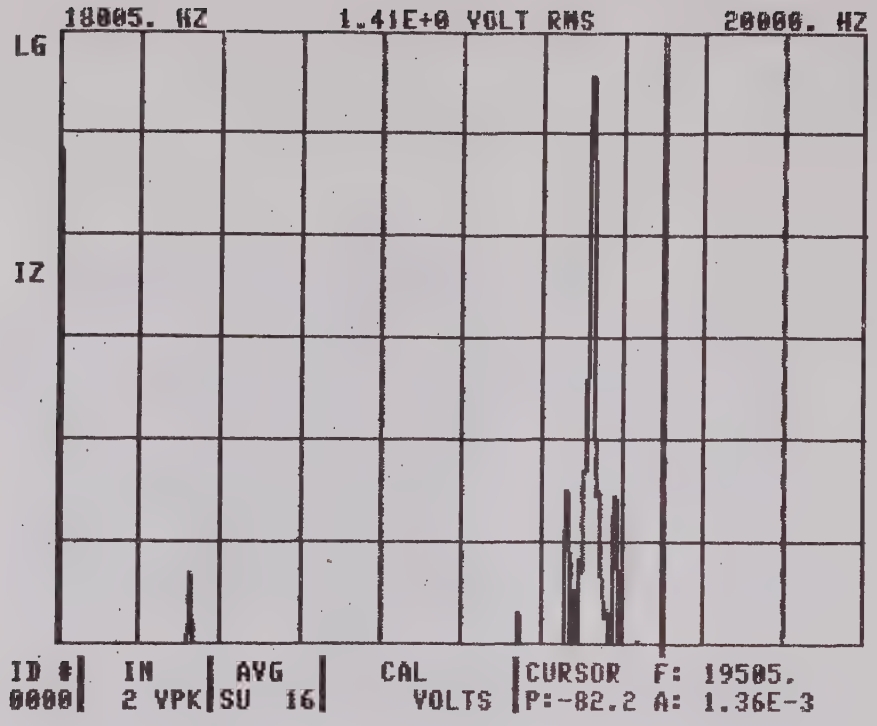


FIGURE 1-9

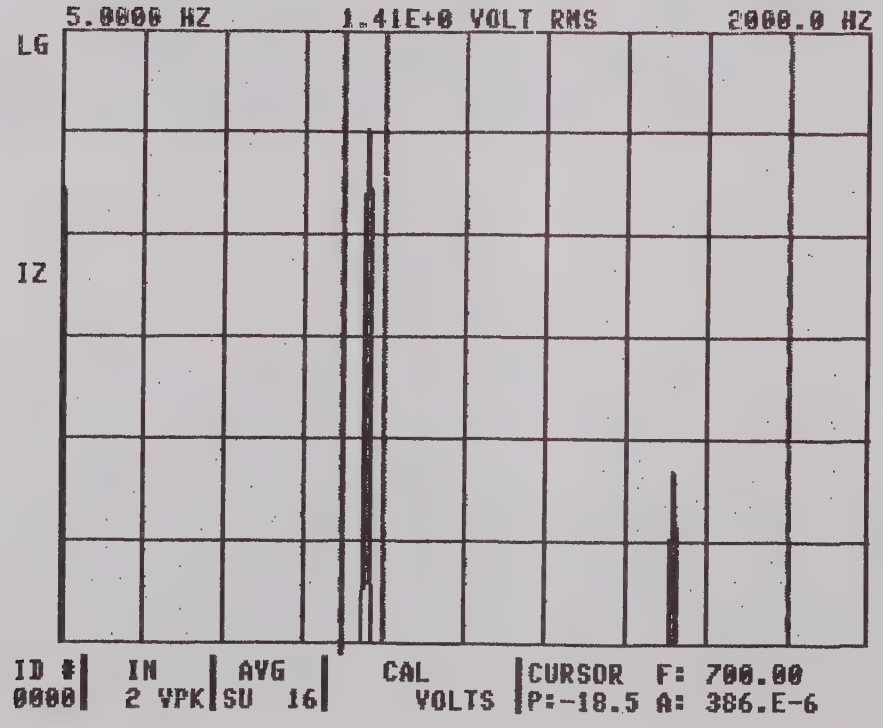


FIGURE 1-10

Data Memory:

The first step in storing data is to recall a memory as the second display, under the display to be stored. To recall M2, delete one of the functions (i.e. delete INST ZOOM) and press M3. If the memory is empty, the display will appear as:

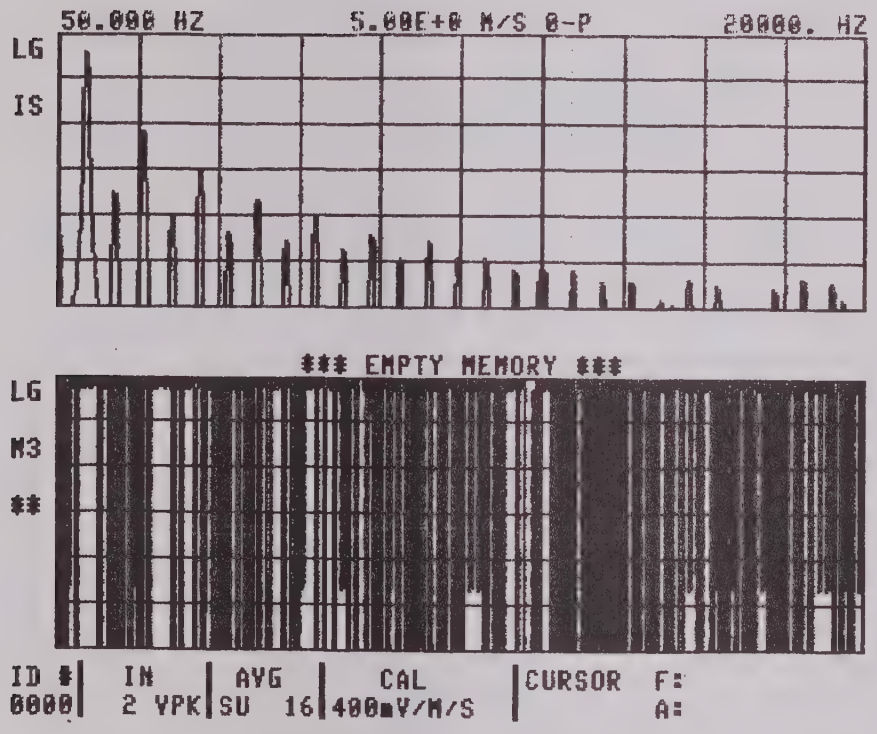


FIGURE 1-11

If the data that is in the memory is not needed, store over it by pressing STORE DATA. The display will immediately reflect the storage:

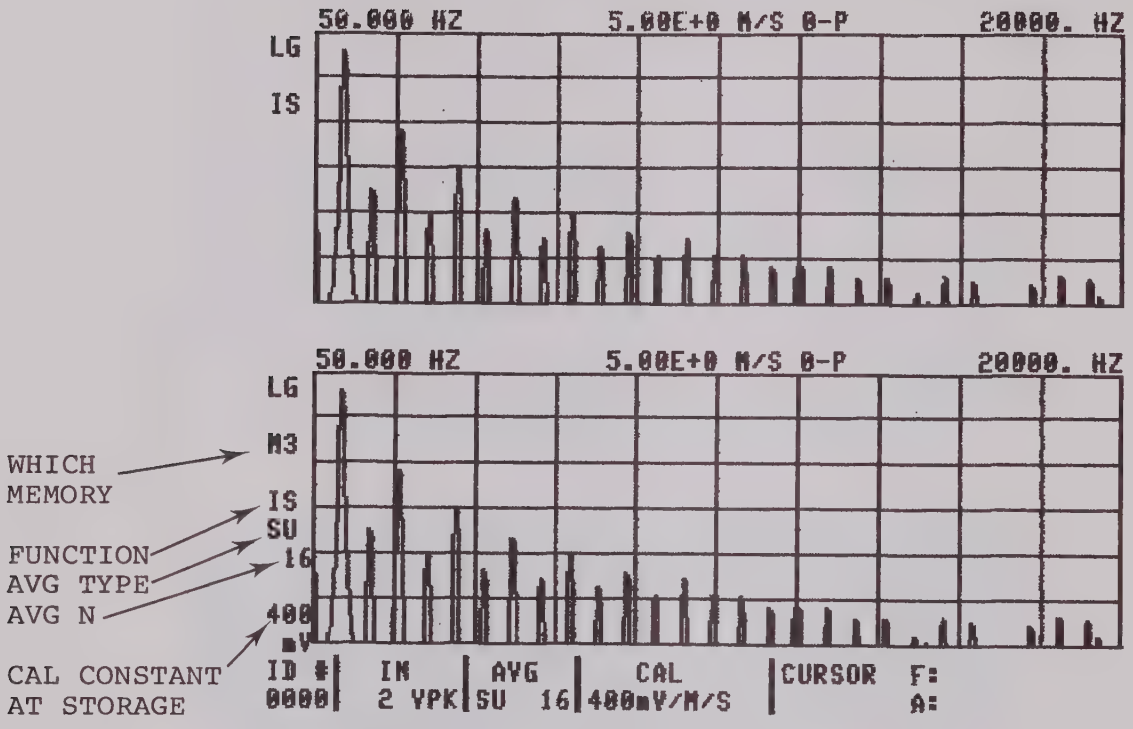


FIGURE 1-12

NOTE:

The annotation on the side and on the top of the memory display reflects the system state at the time of storage.

The bottom line of annotation shows the current system state, as always.

These two notes are clearly illustrated in the next figure.

In the figure below orders (external sampling clock) is used, the averager type and average N are changed, and the CAL constant is changed. On the top display (INSTant SPECtrum), note, that the horizontal limits are now in cell numbers; and the amplitude is in inches per second, zero to peak.

THE MEMORY DISPLAY HAS NOT CHANGED. Its annotation shows what is on that display.

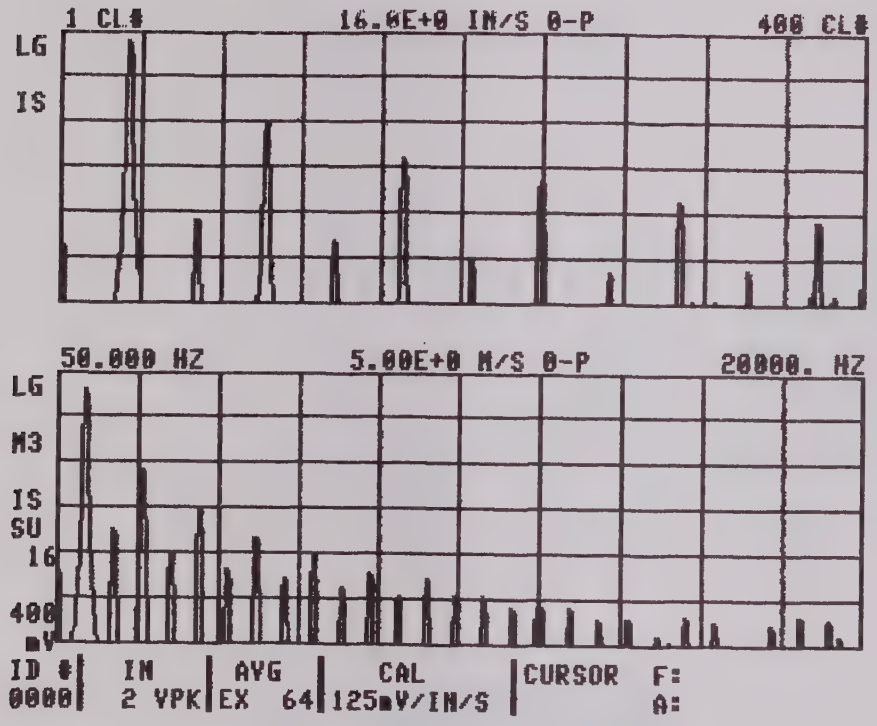


FIGURE 1-13

For the next figure, the INSTant SPEC display is removed, leaving only the memory to show memory annotation in single display. The system state is the same as the previous picture, but, since the cursor is on the memory display, its position is shown in Hz (the same units as the horizontal limits) and the amplitude is in meters per second again.

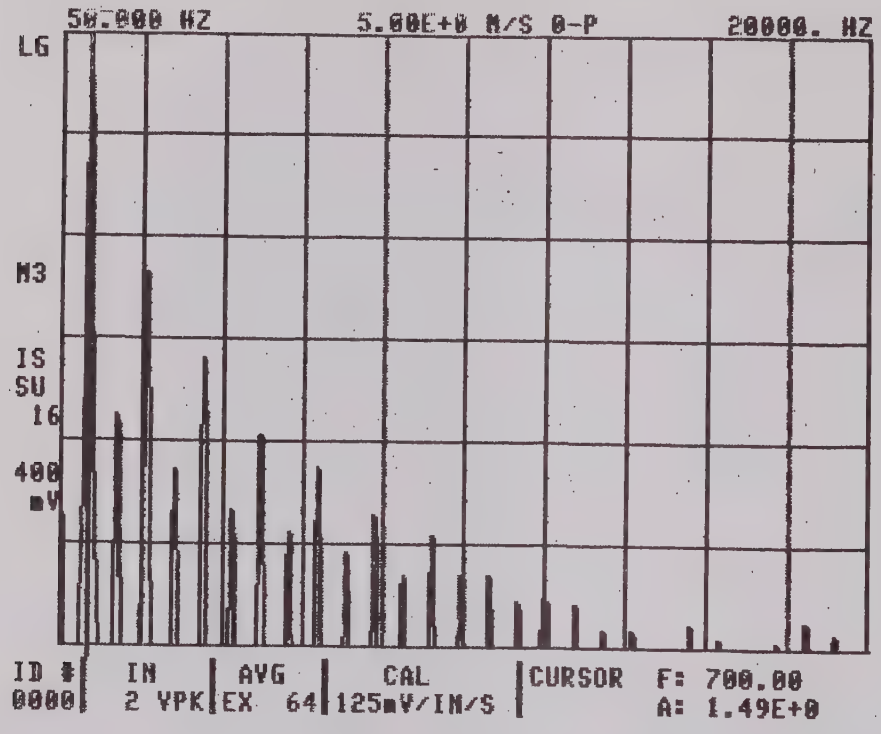
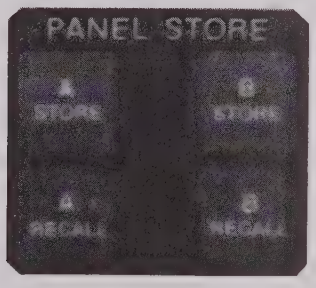


FIGURE 1-14

Panel Store



There are two stored panels, A and B. They are copies in CMOS of the system state table which records the front panel settings (not data). When recalling a panel, the action is as expected - the LED on the A or B RECALL button comes on, and the system state changes to what it was when A or B STORE was pressed. Pressing the recall button again turns

out the LED, and the system reverts to what it was when the RECALL button was pressed at first.

If CMOS contains garbage, store a panel before pressing RECALL, or garbage will be obtained.

Data memories are not retained during power off. Even if one of the displays called for in a stored panel is a memory, it will come up empty.

Weighting:

The Discrete Fourier Transform (and, therefore, the Fast Fourier Transform) produces good looking displays only if the input signal energy is precisely on one of the frequency domain output points. Such a signal is called "cell centered." Signals that are not cell centered appear to have large sweeping skirts which can obscure significant data, and show reduced peak amplitudes.

To correct this problem, a weighting function is usually applied to the time data just before the FFT. The weighting function greatly suppresses the skirts on non-cell centered signals (at the expense of sharpness of peaks in the spectrum). All spectra viewed have so far have been weighted.

Unfortunately, weighting involves discarding portions of the time data going into the FFT. If a continuous signal is viewed (such as machine noise), the data is repetitious. Weighting is worthwhile. On the other hand, if a a transient event is captured (by "triggering," which is covered later), there is no redundancy in the data and the time data can not be thrown away. In this case, it may be worthwhile to view an unweighted spectrum.

The 100A may be instructed to perform FFTs without weighting the time data. To do this, press the SELect button until the inverse video field is positioned between average type and number of averages. Now, pressing either the UP or DOWN buttons will cause a lower case u to appear in this space. Whenever the u is present, the 100A will perform FFT on unweighted data. An unweighted instant spectrum follows:

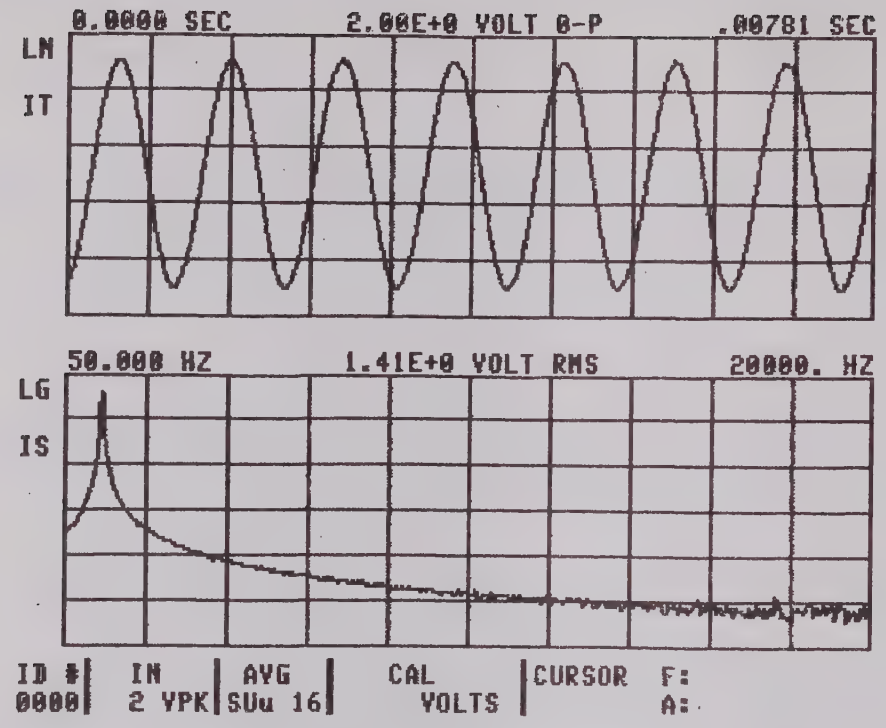


FIGURE 1-15

Note the skirts on the spectrum even though the instant time display shows that the input is a sine wave (energy at only one frequency). Obviously, the input signal is not cell centered.

Summary:

* Use weighting for continuous signals.

* Do not use weighting when capturing transients.

Averaging in the Frequency Domain:

The Nicolet 100A can perform summation, exponential or peak averaging of either weighted or unweighted spectra. The type of averaging is selected with the SELect keys. The average types are labeled SU, EX, or PK. The fourth average type, TI, will be discussed in the next section.

Before discussing summation, peak, and exponential averaging, it is worth noting that the 100A always averages at 0% redundancy; that is, an entirely new time window is collected for each FFT.

Now for the average types:

Summation Averaging - is regular ensemble averaging. Each spectrum is weighted equally as 1/N of the average. Scaling is only correct when the averager reaches N, the preset number of averages to be taken. As previously mentioned, # AVG is set via the SELect keys. While a summation average is in progress, a count of the number of averages completed replaces "N."

Exponential Averaging - is a moving average in time. In this mode, the most recent data is weighted most heavily while old data is weighted lightly. The name arises from the fact that the effect of one spectrum on the average decays exponentially as new spectra are averaged in. In mathematical terms, (New Average) = 1/N (New Spectrum) + (N-1)/N (Old Average). Exponential averaging does not stop at N, since it is only precisely accurate when the number of averages approaches infinity. An exponential average builds to 99% of its final value within 5 x N averages. Exponential averaging with N = 1 entirely replaces the old average with new data on each pass. Exponential averaging may be viewed as a compromise between INSTant SPEC which shows changes immediately but may be noisy, and summation averaging which improves signal to random noise ratio, but does not distinguish old data from new data.

Peak Averaging - is not truly an average. In peak averaging, the largest reading that occurs at any frequency cell is saved as that cell's value. This provides a "worst case" spectrum. Peak averaging is always correctly scaled, showing the largest values to occur at each cell so far. Peak averaging does not stop at N. N has no effect on peak averaging. Peak averaging does not provide signal to noise improvement like summation and exponential averaging.

The averager may be stopped manually by pressing STOP and continued by pressing CONTINUE. Summation averaging will not continue beyond N.

It is sometimes desirable to average only spectra that reflect a specific transient event. To accomplish this, simply press ARM and then AVG START. The 100A will the take data only when it is triggered (See Trigger Section) and will re-arm itself automatically.

To view a frequency domain average, press AVG SPEC. This function need not be viewed during the averaging.

Of course, the functions AVG TIME and SPEC AVG TIME are not valid when the averager buffers contain frequency domain information.

The figure below shows the improvement in signal to noise ratio obtainable with summation averaging. The small peaks which are clearly visible in the average spectrum are practically invisible in the instant spectrum.

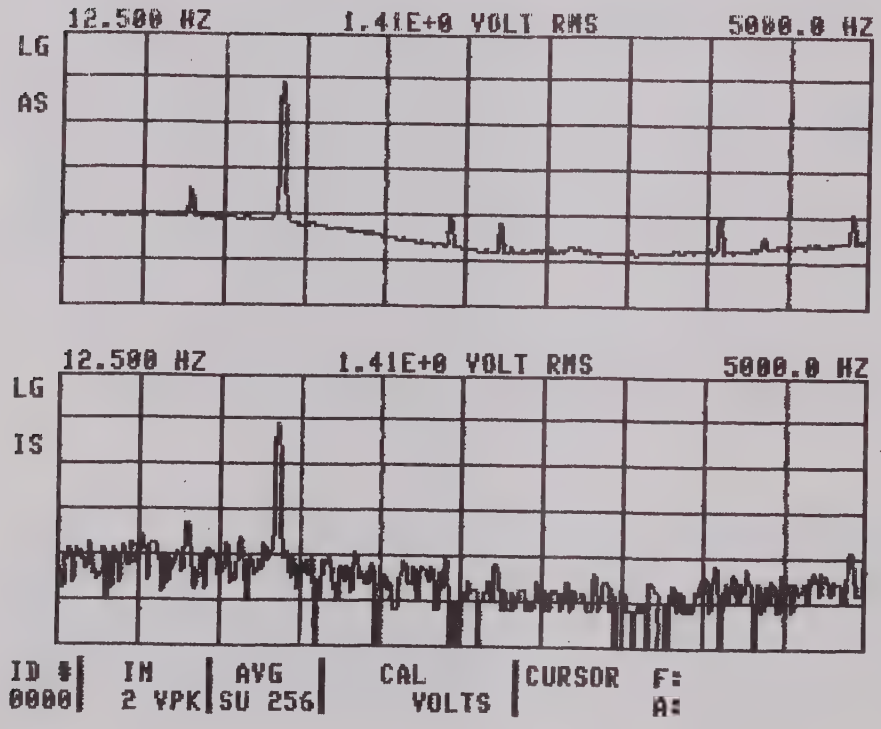


FIGURE 1-16

Averaging Time:

In this averager mode, time histories are summation averaged instead of frequency spectra. Only components of the input signal that are always in the same spot in the time histories will add; non-periodic signals (random noise) eventually average to zero. This makes time averaging an incredibly powerful tool for pulling periodic data out of noise. Time averaging must be done synchronously (i.e., triggered), or everything averages to zero. Therefore, when starting time averaging, the 100A automatically arms itself and waits for trigger. After capturing each time history, the 100A will automatically re-arm itself.

When the averager buffers contain time, the functions AVG TIME and SPEC AVG TIME are valid; AVG SPEC is not.

Spectra of average time can show those components of a machine's noise that are synchronized with its rotation while ignoring non-synchronous energy from bearings, etc. This requires a "once per rev" trigger signal from the machine.

Spectra of average time may be viewed weighted or un-weighted. The weighting function affects only the calculation of the FFT; weighting has no effect on time averaged data.

Time averaging may be manually stopped and continued. Like summation averaging in frequency, time averaging stops automatically at N and will not continue beyond that point. Time averaging is correctly scaled when the averager reaches N and stops automatically.

Figure 1-17 shows an instant spectrum of the triangle wave and noise and the spectrum of average time. Note, that weighting is on for continuous signals. The spectrum of average time clearly shows the fundamental and the third, fifth, and seventh harmonics of the triangle wave. In the INSTant SPEC display, all harmonics are smothered by noise.

Figure 1-18 below shows an instant time signal with 0 dB signal to noise, and the average time signal after 256 averages. The triangle wave is clearly revealed.

While time averaging is in progress, a count of the number of averages completed replaces AVG N.

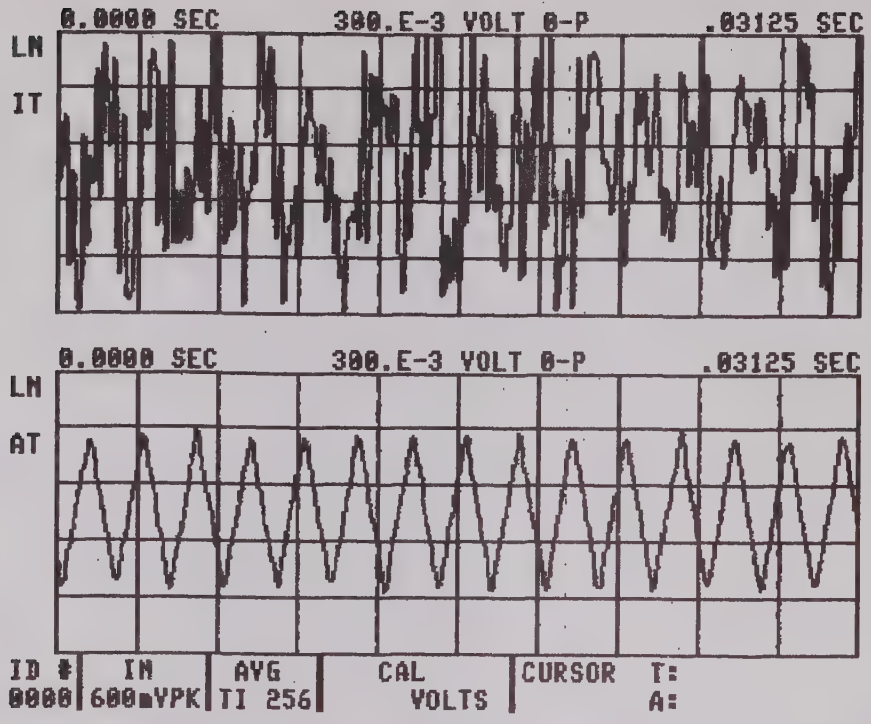


FIGURE 1-17

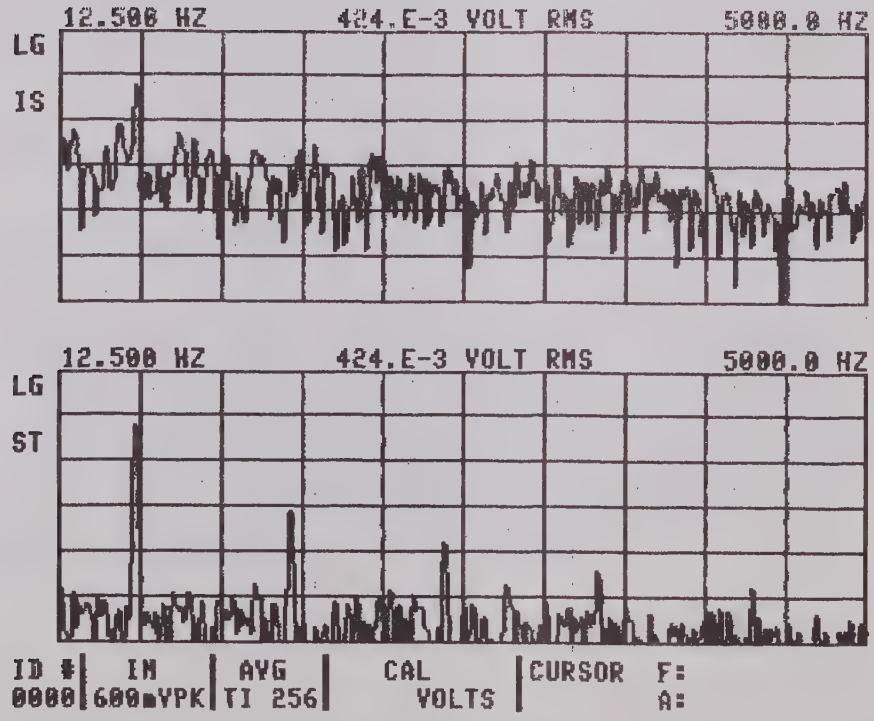


FIGURE 1-18

Average Zoom:

It is possible to use summation, exponential, or peak average with the high resolution, 1/10 baseband zoom spectra. In the same way that instant zoom displays are centered at a the live cursor, average zoom displays are centered at a stored cursor (C1-C4). The corresponding data memory (M1-M4) is used as an averager buffer.

Placing the live cursor at a frequency location that will become the center of an average zoom display and performing the operations below, the average zoom will be done in M1.

STORE CURSOR, C1	Establishes Center.
SET AVG ZOOM, C1	Tells the 100A to perform AVG ZOOM.
AVG START	Starts the averager.

The averager will perform the baseband average as usual and in addition, whatever zoom averages are set will be performed up to all four. View the appropriate memory to see the average zoom.

To tell the averager not to do an average zoom around C1, press SET AVG ZOOM, C1 again. The LED in the arrow to the right of C1 should extinguish.

Note that average zoom displays the higher resolution of zoom plus the signal to noise improvement of averaging. Figure 1-19 shows an instant spectrum on top with an average zoom on the bottom to illustrate this.

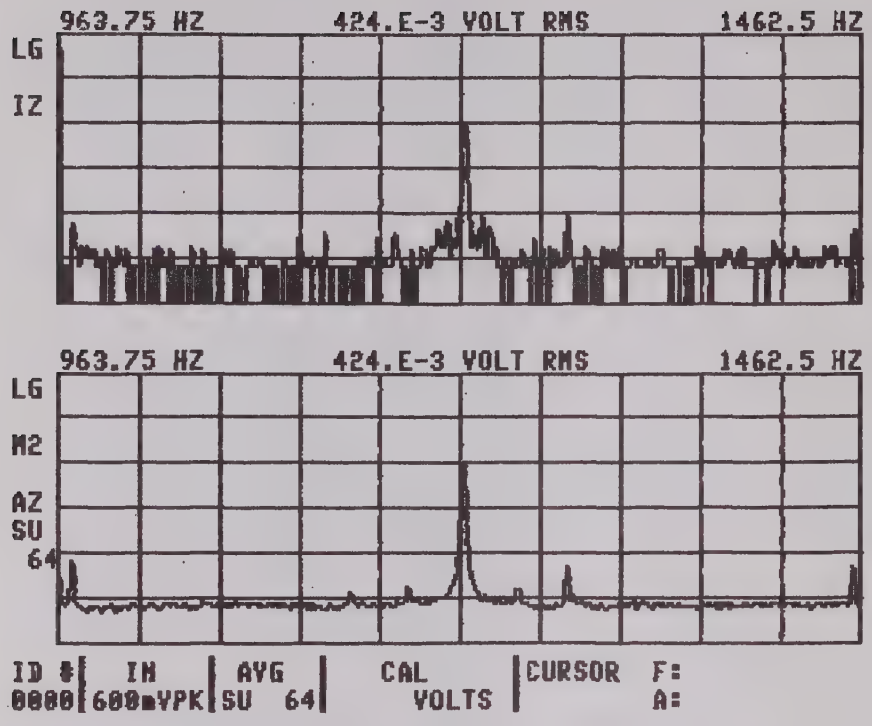


FIGURE 1-19

Note that the average zoom display shows a signal with weak but clearly discernable sidebands. The sidebands are well hidden in the instant zoom display. Both displays are 120 dB high.

Trigger:

The trigger group is pictured on the left. It contains three buttons:

HOLD - Depressing this button, stops the 100A from adding new samples to its input buffer. Averaging is delayed. Instant functions freeze.

ARM - After depressing this button, the 100A to waits for a trigger condition, collects one window of time data, and holds it.

LEVEL - Selects the trigger condition.

The possible trigger conditions are:

1. Upward transition through + 1/4 Input Sensitivity.
2. Upward transition through + 1/2 Input Sensitivity.
3. Downward transition through - 1/4 Input Sensitivity.
4. Downward transition through - 1/2 Input Sensitivity.
5. External pulse (high to low transition).

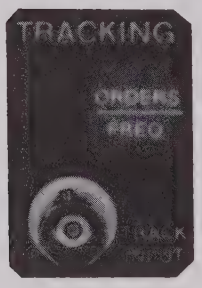
The first four settings are used to trigger on particular parts of the input signal, similar to oscilloscope triggering. The fifth setting, EXTernal, triggers the 100A to collect a new buffer of time data when a low true TTL pulse is seen on the TRIG INPUT BNC connector. This is used for once per revolution pulses from rotating machines, etc. The data in the figures of the Averaging Time Section were collected using the function synch output of a Wavetek Model 132 Signal Generator to trigger the 100A.

If the ARM and HOLD buttons are used manually, the ARM and HOLD functions effect each other as follows:

1. If the analyzer is in the ARM mode, depressing the ARM control returns the analyzer to non-arm mode, while depressing the HOLD takes the analyzer out of the ARM mode and into the HOLD mode.

2. If the analyzer is in the HOLD mode, depressing the HOLD control returns the analyzer to non-hold mode, while depressing the ARM control takes the analyzer out of the HOLD mode and primes the system to be triggered. When the analyzer is triggered, the HOLD LED will illuminate and the ARM LED will remain on while data is being collected. When the data has been collected, the ARM LED will extinguish and the HOLD LED will remain on indicating the analyzer is in the HOLD mode.

Tracking:



If a machine speed is changing while the 100A is averaging its spectrum, the spectrum will be smeared. This smearing is eliminated if the 100A sampling rate is proportional to the machine speed. Furthermore, when the 100A sampling rate varies with a machine speed, input not caused by that machine will smear, reducing its apparent power in the average.

To set the 100A for tracking, press the ORDERS/FREQ button on the unit. The LED should come on. The 100A will now take one sample for each low TTL pulse on the TRACK INPUT BNC connector. Thus, the sampling rate may be derived

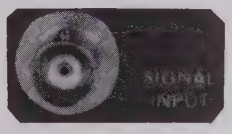
from a machine's rotation; the rightmost displayed cell of the spectrum will be (number of pulses per rev/2.56) orders. For example, 32 pulses per revolution would generate a 12.5 order display.

When the sampling rate is being determined externally (i.e., ORDERS LED is on), the horizontal limits of a frequency or time display will be either cell number or % full scale. The selection of CL# or %FS is controlled by the Hz/CPM button in the MEASURE section.

The tracking input is conditioned before it is used to generate the input sampling signal. The signal level at the tracking input should be less than 15V peak to peak and greater than 2V peak to peak.

WARNING: The frequency range selected determines the anti-aliasing filter. The sampling rate must be greater than 2.56 times the frequency range selected or aliasing may occur. Be sure to select the proper range. If large amounts of time will be spend order tracking or if machine speed varies greatly, the Nicolet Model 24C Spectrum tracking adapter with its optional Tracking Anti-Aliasing filter will prove useful. The 24C also provides multiple pulses per rev from a once per rev signal.

ICP SIGNAL INPUT:



Some transducers have built-in amplifiers or other circuitry. Such a transducer needs to draw current to power these circuits from the cable that connects it to the 100A, and will return its information as voltage modulation.

The Nicolet 100A has two SIGNAL INPUT connectors, one on the front panel and one on the rear panel. The rear panel SIGNAL INPUT connector is an ICP (Integrated Circuit Power Supply) input. It supplies a 4 mA constant current and interprets changes in voltage as returned information.

The switch just above the ICP SIGNAL INPUT determines whether the ICP SIGNAL INPUT or the front panel input connector is active. The input connector not selected is ignored. It is recommended that any signal on the input connector which is not in use be disconnected to avoid any capacitive coupling through the switch.

Rear Panel Connections:

TRIG INPUT and TRACK INPUT are exactly the same as their front panel counterparts. The rear and front panel TRIG and TRACK inputs act identically at all times as described above.

The four connectors on the rear panel are TRIG INPUT, TRACK INPUT, COMPOSITE VIDEO OUTPUT, and VIDEO OUTPUT TO PRINTER.

The COMPOSITE VIDEO OUTPUT connector provides an encoded video and synch signal which may be used with any standard video monitor. Note that the display of the 100A uses nearly the entire available picture area. Many monitors do not display the outside edges of the picture, which may cause the edges of the 100A display to be dropped off. This phenomenon, called overscan, can be adjusted for on the monitor using the vertical height and horizontal width controls.

The VIDEO OUTPUT TO PRINTER connection provides the same information as the composite video output, but it is not encoded. This connecotr is intended for use with the Nicolet 132A Video Printer. The 132A also will accept composite video on its BNC connector. The separate VIDEO OUTPUT TO PRINTER is provided so that the 132A and a large screen monitor may be used at the same time.

Each board in the 100A has a red LED indicating that power is being supplied to that board. These power indicators are visible through the top air holes on the rear panel.

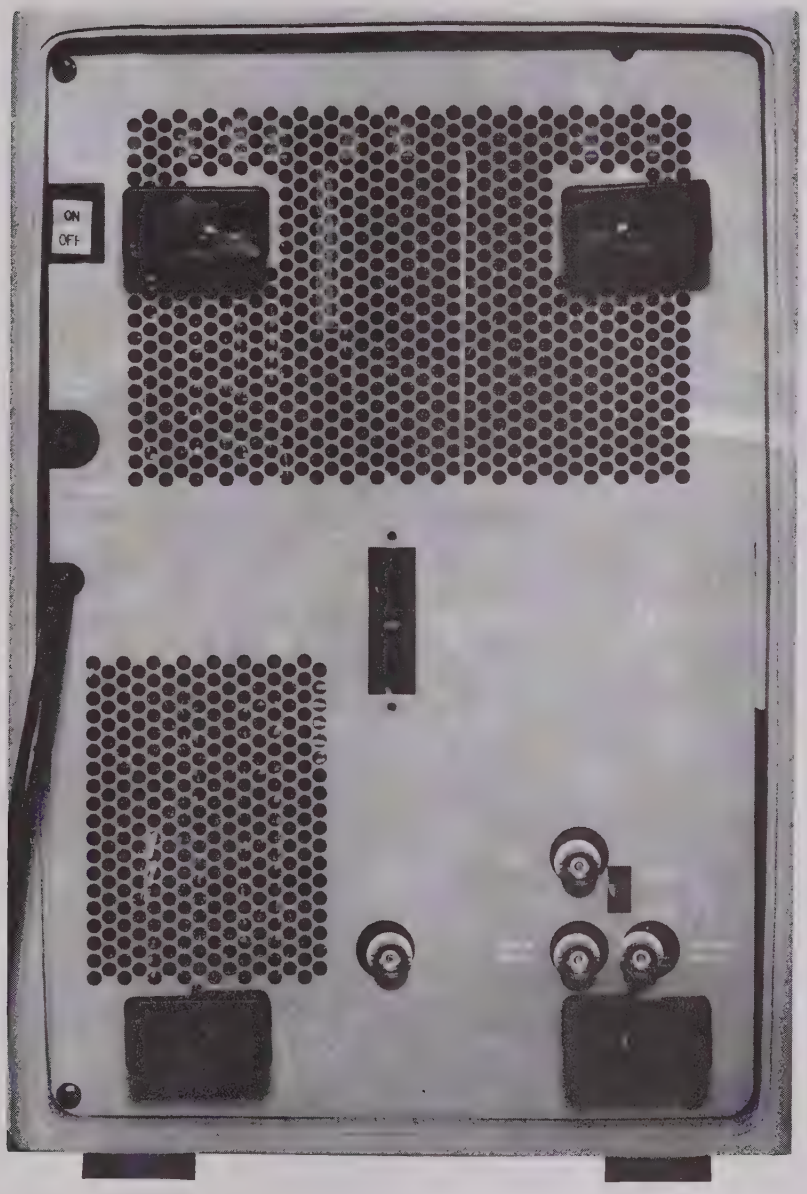


FIGURE 1-20. Nicolet 100A Mini-Analyzer Rear Panel.

SPECIFICATIONS

INPUT

A. SENSITIVITY - 20mv - 10V, 0 - Peak,
Adjustable in 10 dB (~3:1) Steps.

B. IMPEDANCE - 100 Kohms.

C. COUPLING - AC, -3 dB at 0.2 Hz.

D. AMPLITUDE INDICATORS - Overload light for in-range (digital) and out-of-range (analog) overload; LOW light indicates if input is below -24 dB (1/8 Full Scale) and NORMAL light indicates if input is between Full Scale and -24 dB.

E. FILTERING - Anti-aliasing filters on each range, 120 dB per bandwidth octave roll off to -60 dB.

F. SAMPLING - Internal at 2.56 times maximum frequency in the analysis range; External TTL sampling input 51.2 kHz maximum.

ANALYSIS

A. BASEBAND - 0-20 Hz (1200 CPM) to 0-20,000 Hz (1200 kCPM) in 10 ranges.

B. ZOOM - Any 10% of the baseband range, selected as ±5% about cursor during or after 10,240 sample memory load.

C. RESOLUTION - 400 resolution elements in baseband or zoom spectrum.

D. SPEED - Five frequency spectrum per second for baseband; About one spectrum per second for zoom on continuous data or for the first zoom on held data, after which each window is produced as soon as the cursor is moved.

E. DYNAMIC RANGE - 60 dB.[1]

F. WEIGHTING - Selectable Hanning or Flat (Uniform).

[1]50dB 20mv sensitivity.

AVERAGING

A. TYPE -

Sum:	Frequency (400 resolution elements)
Exponential:	Frequency (400 resolution elements).
Peak Profile:	Frequency (400 resolution elements).
Time:	Time (1024 samples).

B. NUMBER - 1, 4, 16, 64, 256.

C. REDUNDANCY - 0%.[2]

D. CALCULATION - Power averaging in frequency with readout in linear units. Voltage averaging in time.

E. ZOOM - From one to four preset frequency zoom bands plus one baseband spectrum can be averaged and stored simultaneously, each of 400-line resolution.

STORAGE

A. DATA - Any four displays can be stored in four 400-line (volatile) memories on command [M_1-M_4] Or up to four averaged zoom bands can be automatically and simultaneously stored, where zoom bands are set by four stored cursor locations [C_1-C_4] prior to averaging.

B. PANEL - Three complete control setup states - Panel A, Panel B, and the Current Panel Active at the time power is turned off, are retained in non-volatile memories; each setup includes all annotation (ID#, calibration, display gain, conversions, etc.) as well as four stored cursors and the type of data display.

C. CURSOR LOCATION - Four cursor locations can be stored in a non-volatile memory (C1, C2, C3 and C4). In addition, panel storages A and B also retain four cursor locations each in their non-volatile memories; stored cursors can be used to set zoom bands to be averaged or can be recalled to the display (total number of stored cursors is 12, held in 3 sets of 4) for repeated measurements at the same frequency or time.

[2]Except during frequency transient averaging.

DISPLAY

A. SIZE - 5" Diagonal.

B. TYPE - Raster scan.

C. DATA - Instant or averaged display of time, baseband frequency or zoom frequency displayed singly or in pairs; Any data display can be stored in any of four 400-word memories and the contents of the memory displayed singly or as a dual display with any other display, (i.e. instant time/averaged time; instant frequency/zoom frequency; instant time/instant frequency, etc.); 1024 sample or 10240 sample time histories are displayed, 400 samples at a time centered at cursor.

D. VERTICAL SCALES - In linear, four division with X2 (6 dB) gain steps to X512 max; In log, 60 dB fixed display window with variable display gain in 10 dB steps. In dual display gain is active on trace with cursor.

E. HORIZONTAL SCALE - Linear time or frequency.

DISPLAY ANNOTATION

A. CURRENT SETUP - (Set with SETUP Keys)
- 4-Digit ID Number
- Input Sensitivity
- Averaging Type
- Weighting ON/OFF
- Averaging Number
- Calibrations in mv/(Unit)

B. DATA DISPLAY - Left (Minimum) Edge of Graticule (in Hz or sec.)
- Right (Maximum) Edge of Graticule (in Hz or sec.)
- Top of Graticule (In Same Units as Sensitivity Calibration)
- Type of Data Display

C. DATA MEMORY ANNOTATION
- above, plus (Stored with Data)
- Memory # (M1, M2, M3, or M4)
- Average Type
- Averaging Number
- Cal Constant
- Weighted/Unweighted

D. MEASUREMENT CURSOR
- Amplitude
- Horizontal Position
- Phase (Where Applicable)

CALIBRATION

A. UNITS - Consistent for setup, data display and cursor in g(0 - pk), in/s (0 - pk), M/s (0 - pk), in(PTP), M(PTP), V (0 - pk), EU (0 - pk)(where "EU" is any engineering unit of measure), or dB.

B. UNIT CONVERSIONS - The following amplitude display conversions can be initiated on command:

1. g(0 - pk)[3] converted to velocity (0 - pk), in/sec or M/s.
2. Velocity (0 - pk)[3] converted to displacement (PTP), in or m.
3. Any unit converted to (units)^2/Hz, i.e. PSD = g^2/Hz.

C. SENSITIVITY - .01 mv/(Unit) to 999 V/(Unit) Sensitivity.

CURSOR MEASUREMENTS

A. AMPLITUDE - Units of calibration with conversions.

B. PHASE - Reads on instant spectrum, instant zoom or spectrum of averaged time. Phase is not corrected for anti-aliasing filter phase characterisitics.

C. HORIZONTAL - Hz, CPM, Sample Number Sec, or Min (from left edge of display, which is "earliest" time sample), or Cell # or % Full Scale if order tracking.

TRANSIENT CAPTURE

A. MANUAL (ARM)

1. Baseband (Non-Zoom). Collects 1024 points of time data and then freezes (HOLDs) the input buffer.

2. Zoom. Collects 10240 points of time data then freezes (HOLDs) the input buffer.

B. AUTOMATIC (ARM)

1. Time averaging (TI). Collects 1024 points of time, automatically re-arms the system for the next transient until preset averaging count is reached.

[3]G(m) single integration yields "m/s", double integration yields "M"; G(E) single integration yields "in/s", double integration yields "in". Both read g when integration is off.

2. Frequency averaging (SU, EX, PK). The system must be armed prior to starting a frequency average. The system collects 896 points of time (128 point pre-trigger window) and automatically re-arms for the next transient until preset average count is reached.

TRIGGERING

A. SOURCE - From the signal input or from a separate external (EXT) trigger signal, + .5 to 5V TTL logic.

B. LEVEL - Adjustable -1/2, -1/4, +1/4, +1/2 of full scale of the signal input or positive, negative edge of the (EXT) TTL input.

TRACKING

External sampling signal at 2.56 the highest frequency desired, provides spectrum whose coverage varies with external sampling rate; external sampling signal at 2.56 x N x machine speed, provides a constant display of N-orders regardless of speed.

PHYSICAL

A. SIZE - 8.50 inches (21.6 cm) Wide;

12.13 inches (30.8 cm) High;

12.53 inches (31.8 cm) Overall, including feet;

21.75 inches (55.25 cm) Deep;

23.25 inches (59.0 cm) including front and rear covers.

B. WEIGHT - 35 lbs. (15.9 kgm) max.

C. POWER - 100, 110, or 220V ± 10% (specified at time of order); 50/60 Hz, 200W max.

WARRANTY

Nicolet Scientific Corporation warrants each instrument manufactured by it to be free from defects in material and workmanship. Our liability under this warranty is limited to the servicing or adjusting any instrument returned to the factory for that purpose and to replace any defective parts thereof. This warranty is effective for one year after delivery to the original purchaser when the instrument is returned, transportation charges prepaid by the original purchaser, and when upon examination it is disclosed to our satisfaction to be defective. If the fault has been caused by misuse or abnormal conditions of operation, normal service charges will prevail. In this case, an estimate will be submitted before the work is started. Warranty returns must first be authorized by Nicolet Scientific Corporation.

All equipment not manufactured by Nicolet Scientific Corporation is subject only to the warranty provided by the supplying manufacturer.

No other warranties are expressed or implied, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose. Nicolet Scientific Corporation is not liable for consequential damages.

If this product is sold as part of a Nicolet Scientific Corporation integrated system, the above warranty shall not be applicable, and this product shall be covered only by the system warranty.

Nicolet Scientific Corporation reserves the right to make changes in the design of its instruments without incurring any obligation to make the same changes on equipment previously purchased.

CLAIM FOR DAMAGE IN SHIPMENT

The instrument should be tested as soon as it is received. If the instrument is damaged in any way, a claim should be filed with the carrier. A full report of the damage should be obtained by the claim agent. If service is required, notify our Customer Service Department for service data or shipping instructions. Include model number, serial number, and purchase order number when referring to this instrument for any reason.

SHIPPING

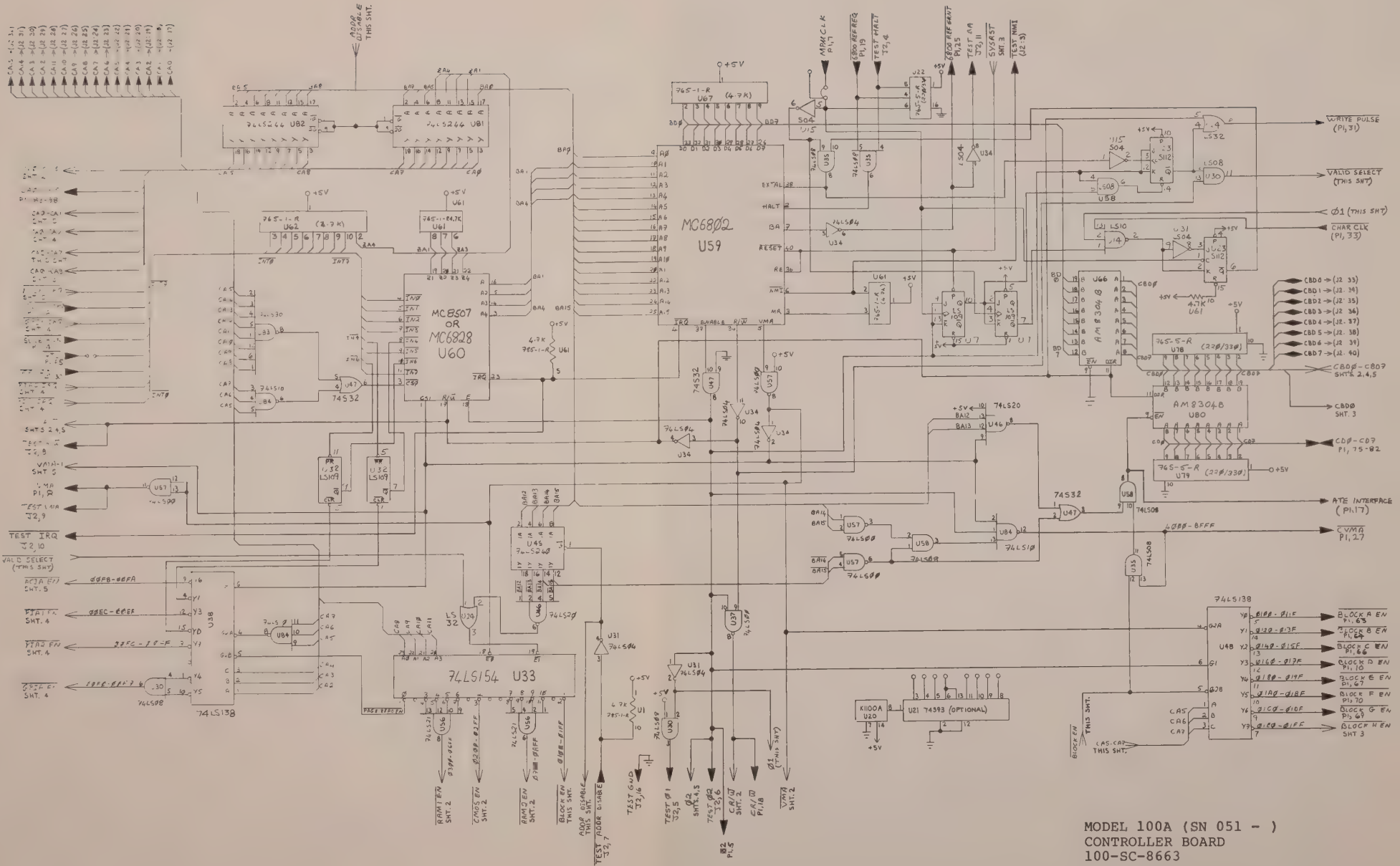
If the unit fails to operate or any fault develops, the following steps should be taken:

1. Notify us, giving full details of the difficulty, and include the model number and serial number of the equipment. On receipt of this information, we will give you service data or shipping instructions.

2. On receipt of shipping instructions, forward the instrument prepaid to Nicolet Scientific Corporation. If requested, an estimate of the charges will be made before the work begins, provided the instrument is not covered by the warranty.

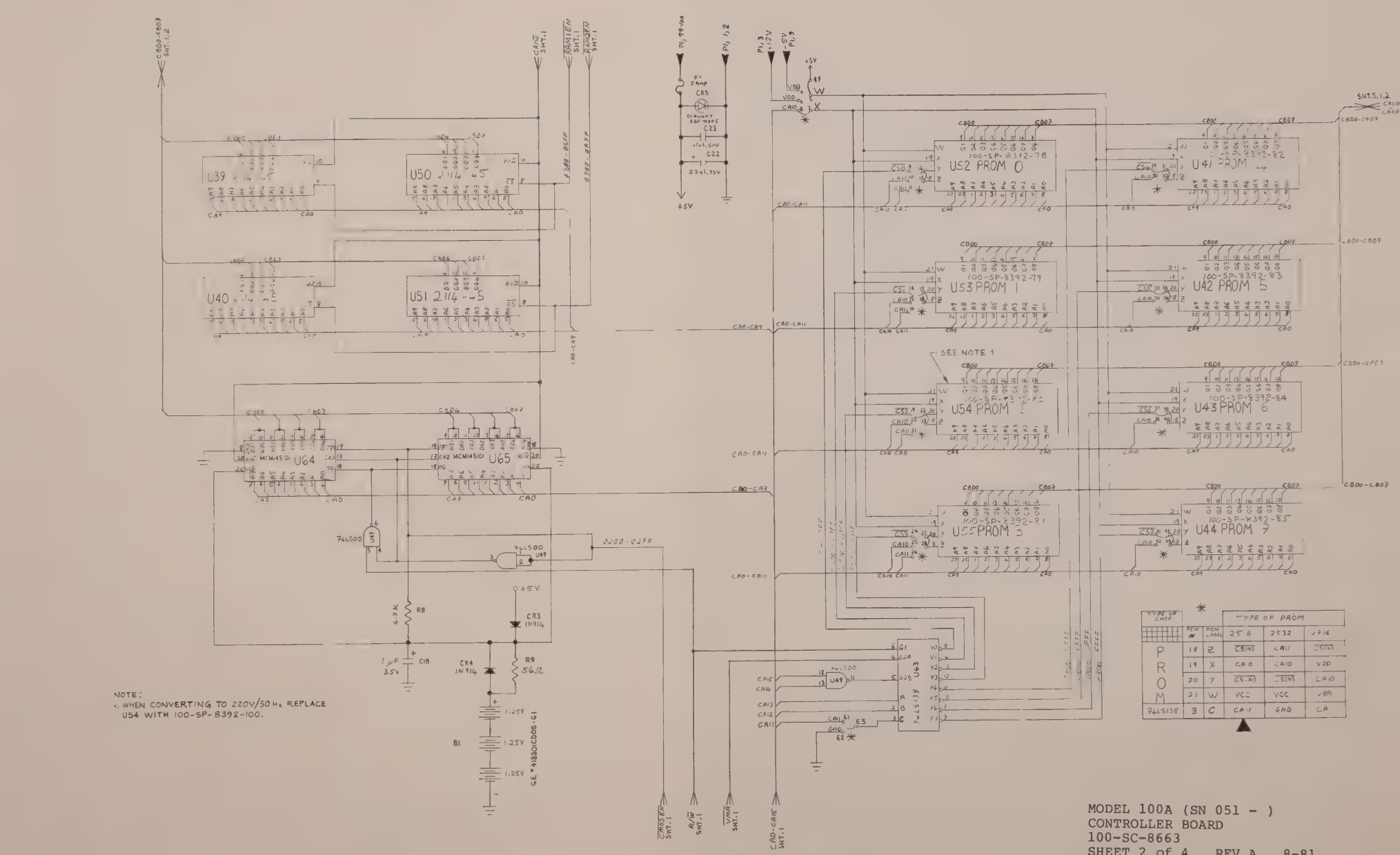
3. If the instrument is to be shipped, it is imperative that it be properly packaged. Where possible, use the specially designed packaging material in which the unit was delivered.

This warranty is expressly in lieu of all other obligations or liabilities on the part of Nicolet Scientific Corporation, which neither assumes nor authorizes any person to assume for it any other liability in connection with the sale of its instruments.



MODEL 100A (SN 051 -)
CONTROLLER BOARD
100-SC-8663
SHEET 1 of 4 REV A 8-81

©Nicolet Scientific Corporation 1981

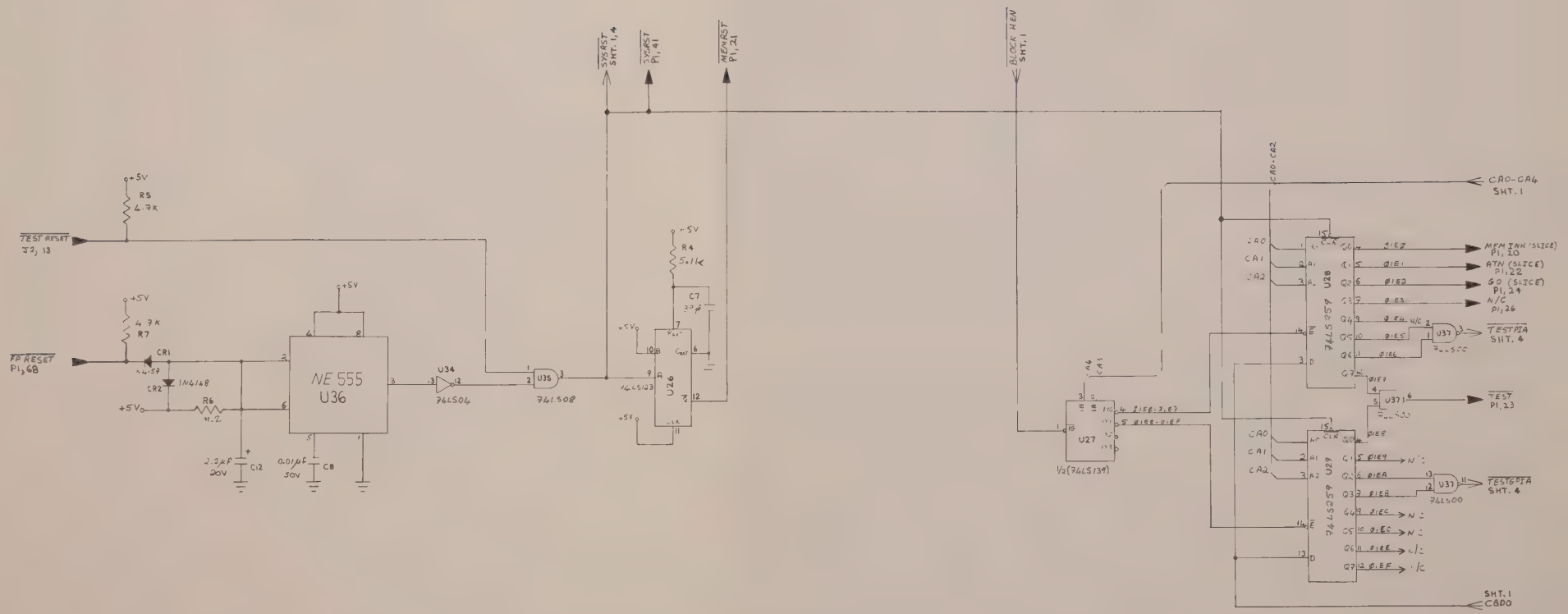


TYPE OF CHIP			TYPE OF PROM		
	PIN #	PIN NAME	2516	2532	2716
PROM	18	Z	CS(N)	CA11	CS(N)
	19	X	CA0	CA10	VDD
	20	Y	CS(N)	CS(N)	CA10
	21	W	VCC	VCC	VBB
74LS138	3	C	CA1	GND	CA

NOTE:
1. WHEN CONVERTING TO 220V/50 Hz REPLACE U54 WITH 100-SP-8392-100.

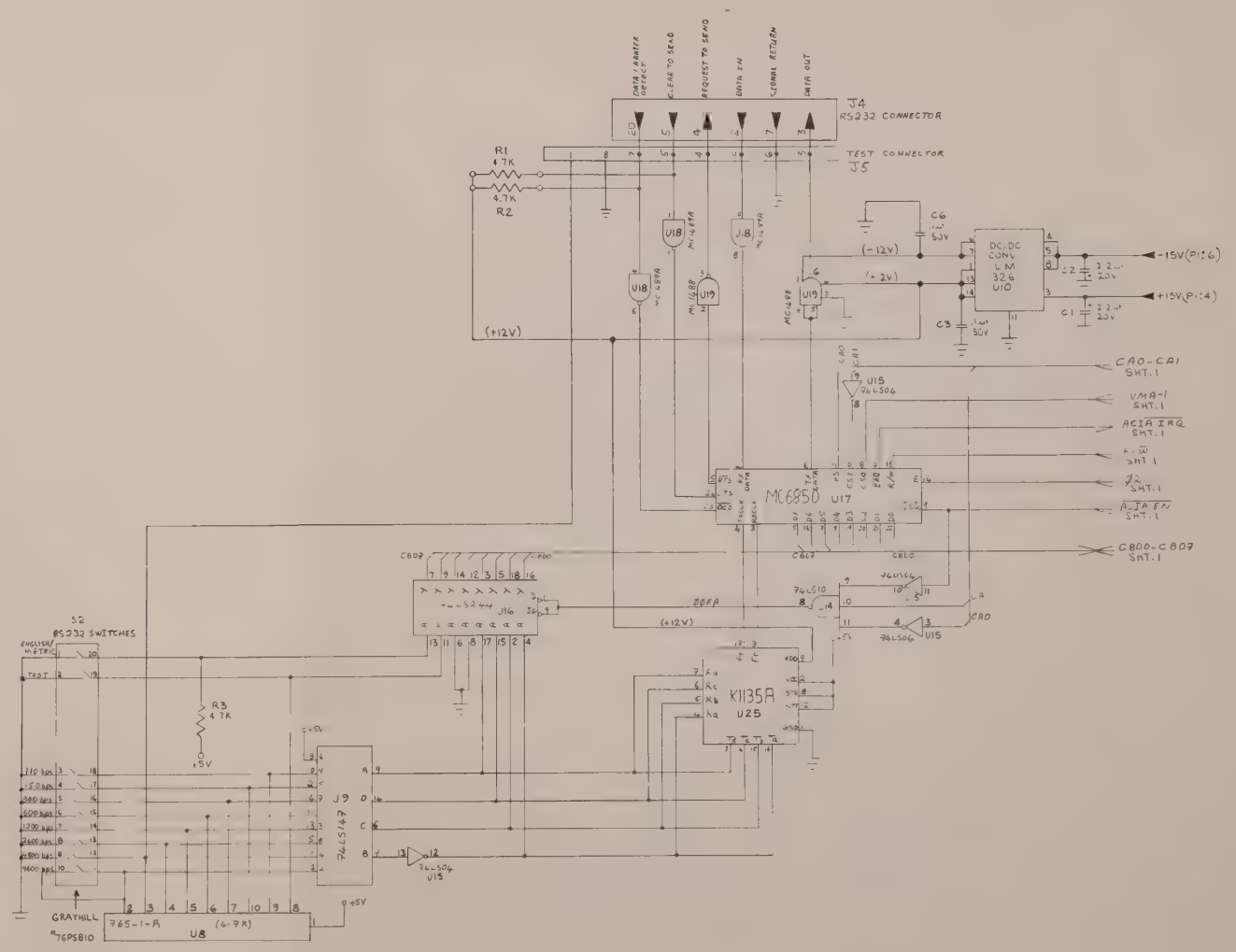
MODEL 100A (SN 051 -)
CONTROLLER BOARD
100-SC-8663
SHEET 2 of 4 REV A 8-81

©Nicolet Scientific Corporation 1981



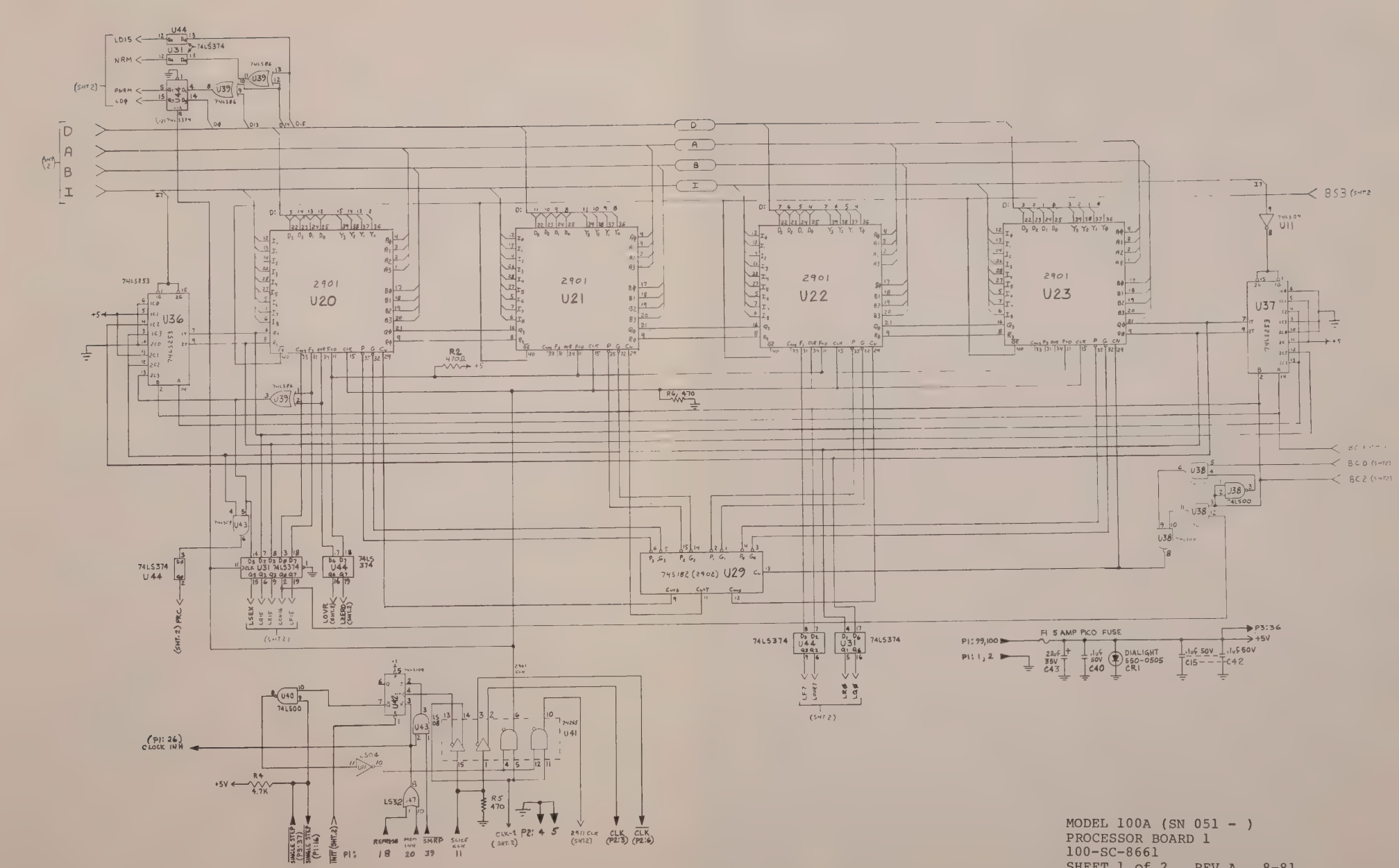
MODEL 100A (SN 051 -)
CONTROLLER BOARD
100-SC-8663
SHEET 3 of 4 REV A 8-81

©Nicolet Scientific Corporation 1981



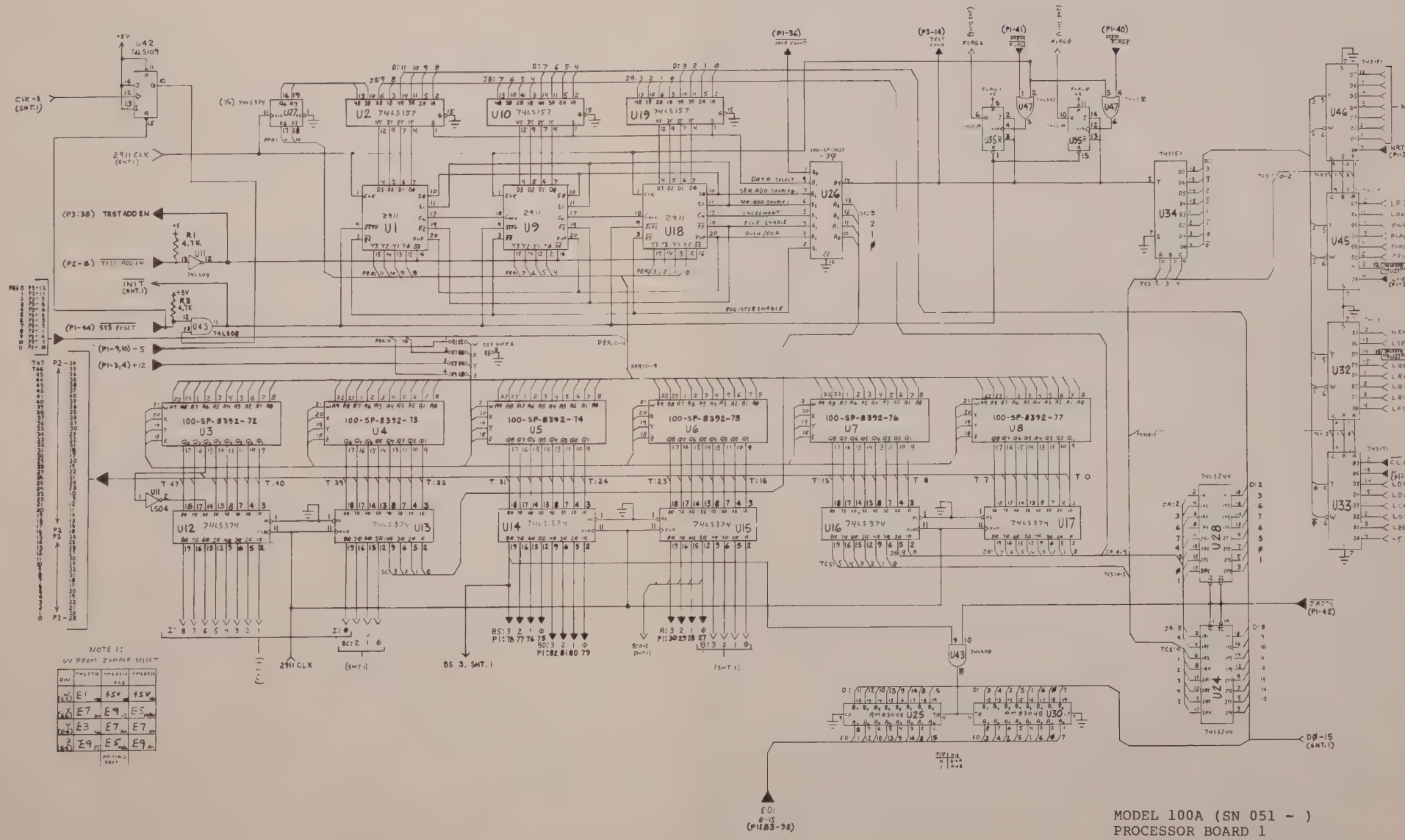
MODEL 100A (SN 051 -)
CONTROLLER BOARD
100-SC-8663
SHEET 4 of 4 REV A 8-81

©Nicolet Scientific Corporation 1981



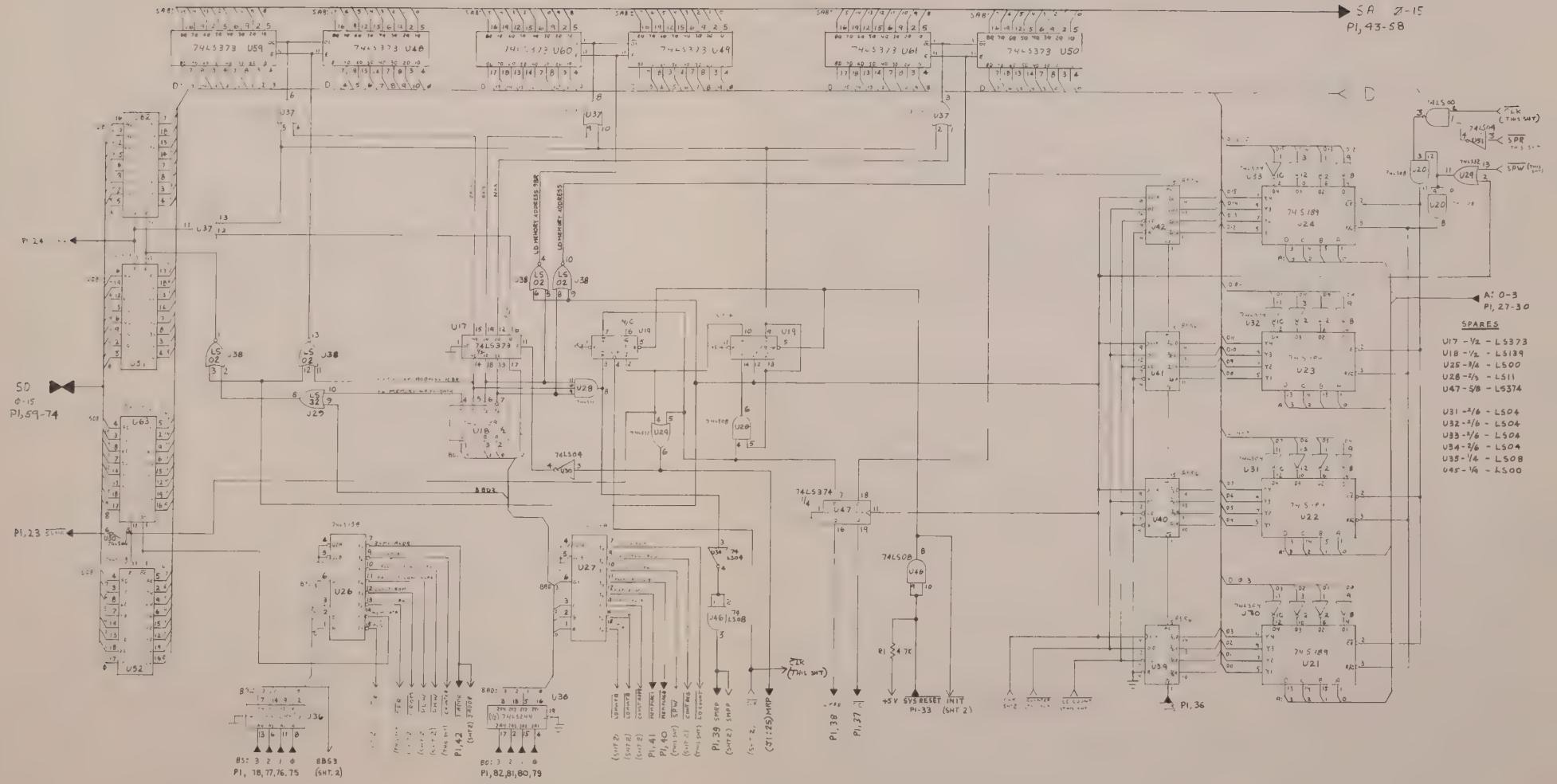
MODEL 100A (SN 051 -)
PROCESSOR BOARD 1
100-SC-8661
SHEET 1 of 2 REV A 8-81

©Nicolet Scientific Corporation 1981



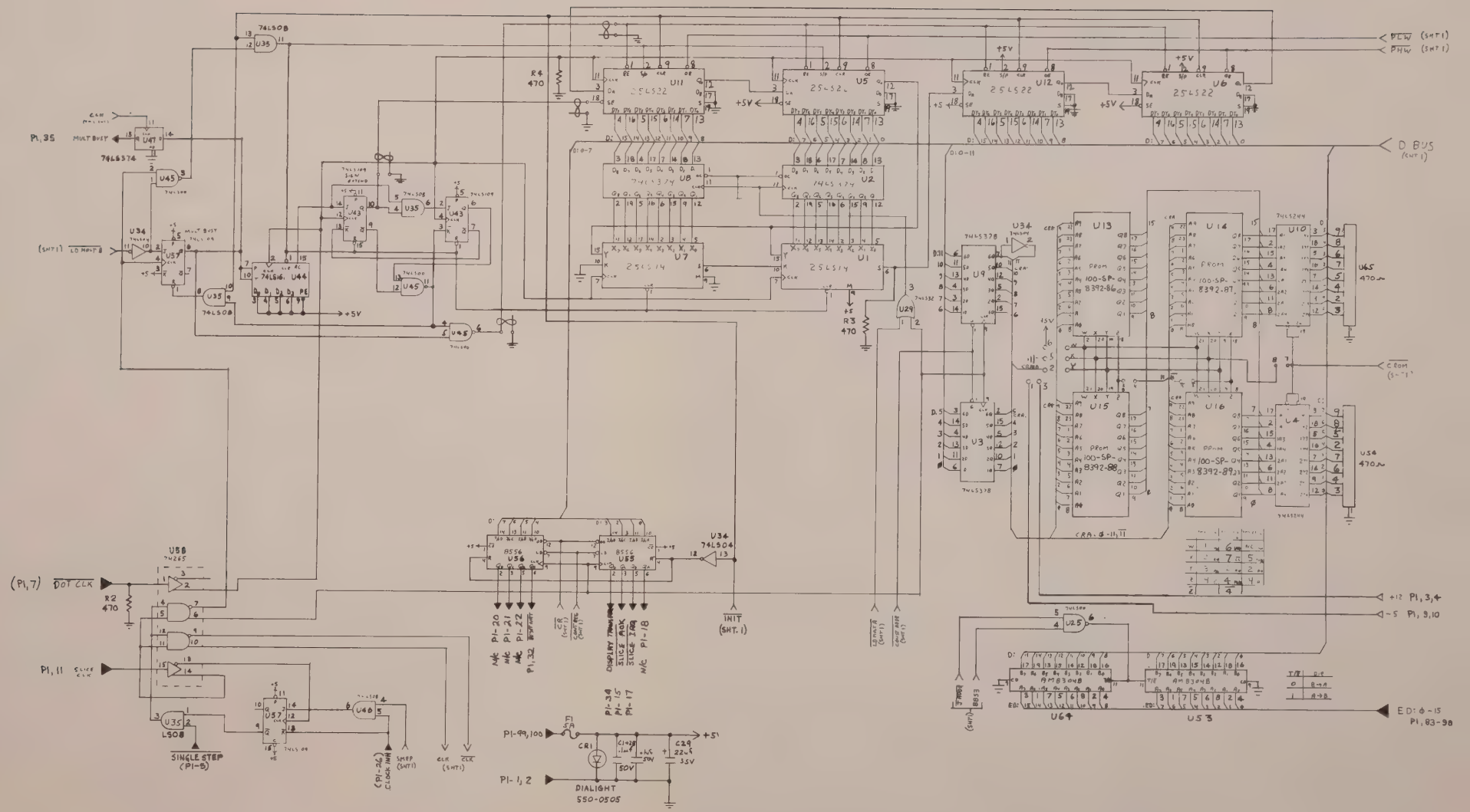
MODEL 100A (SN 051 -)
PROCESSOR BOARD 1
100-SC-8661
SHEET 2 of 2 REV A 8-81

©Nicolet Scientific Corporation 1981



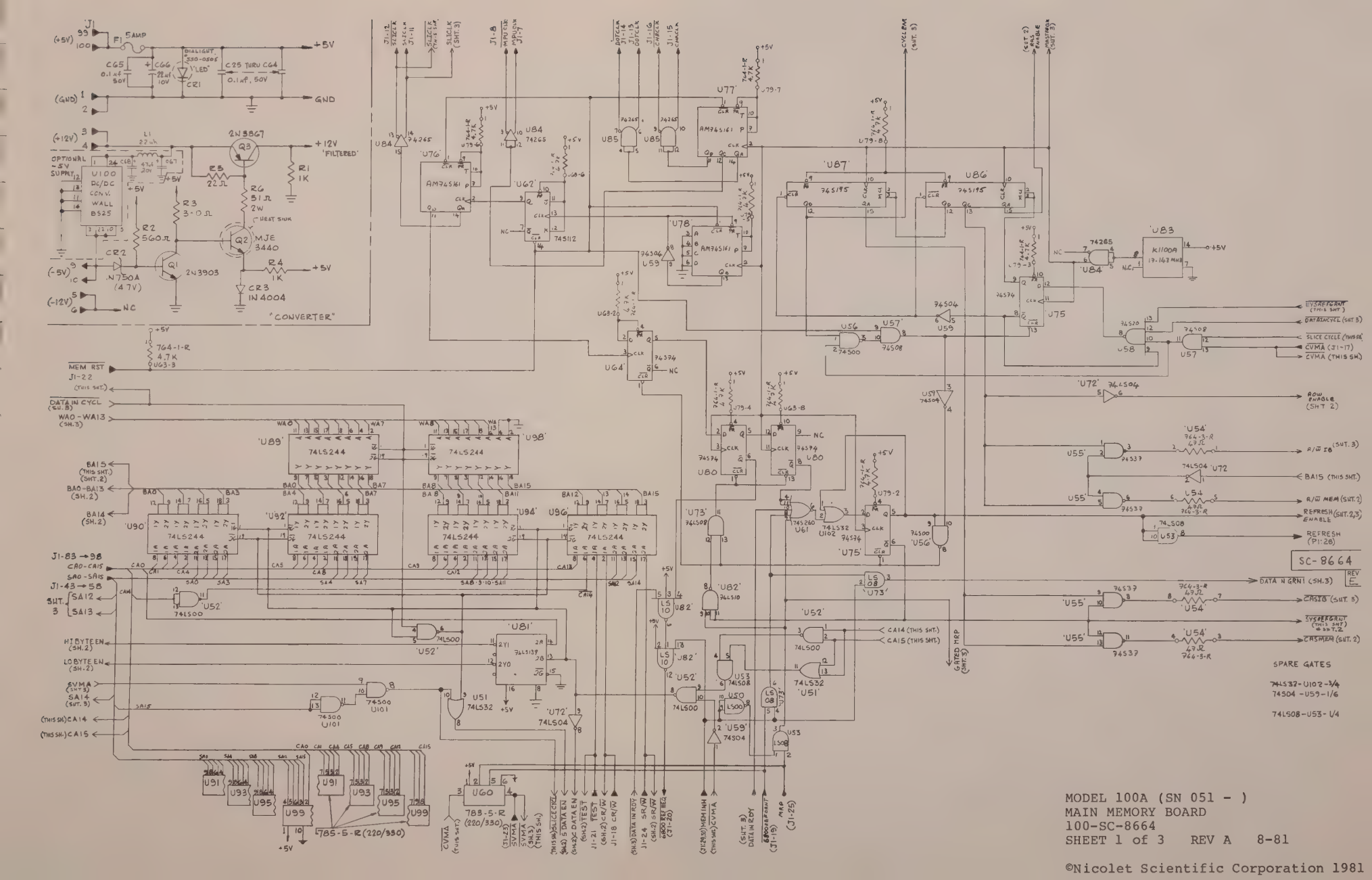
MODEL 100A (SN 051 -)
PROCESSOR BOARD 2
100-SC-8662
SHEET 1 of 2 REV A 8-81

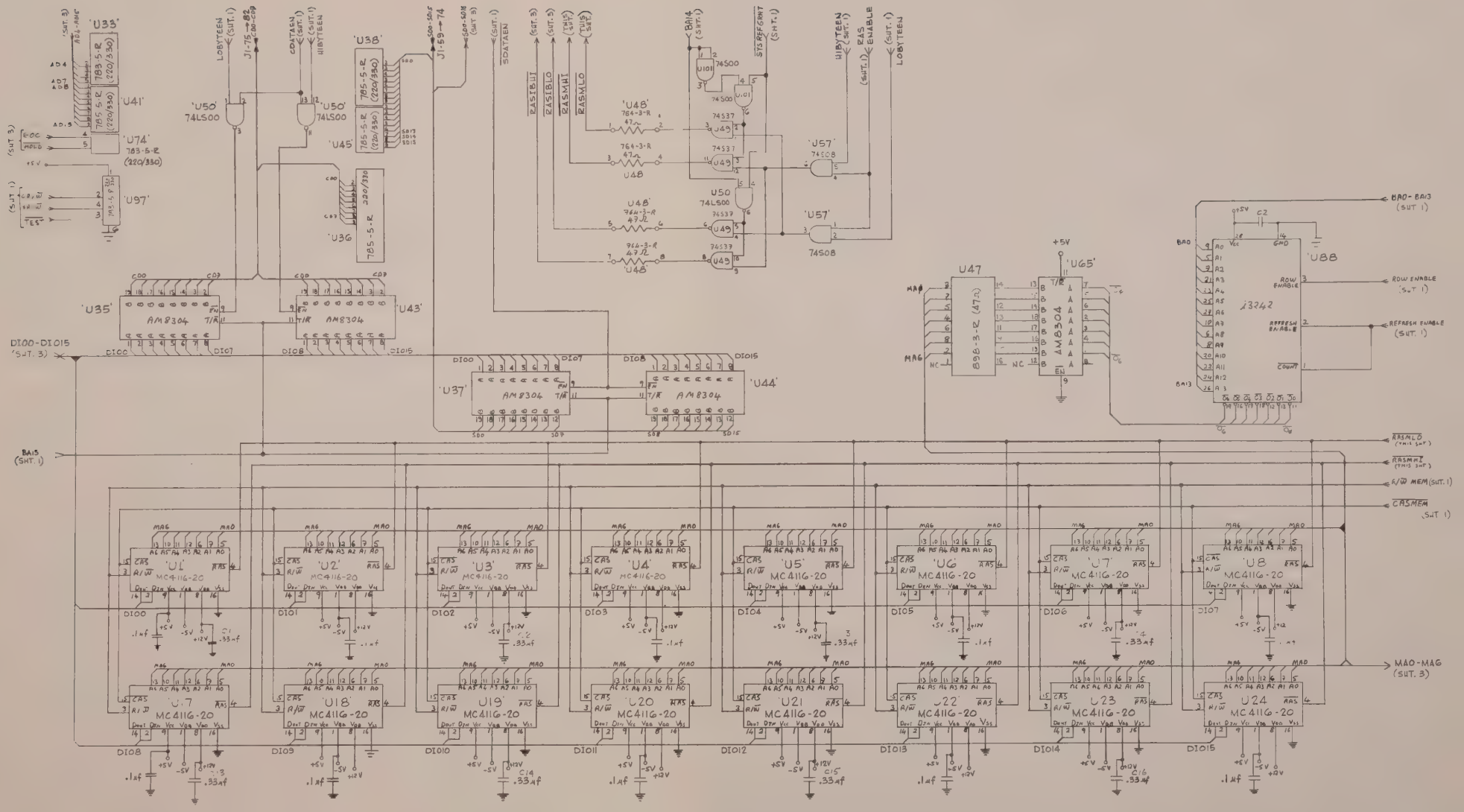
©Nicolet Scientific Corporation 1981



MODEL 100A (SN 051 -)
PROCESSOR BOARD 2
100-SC-8662
SHEET 2 of 2 REV A 8-81

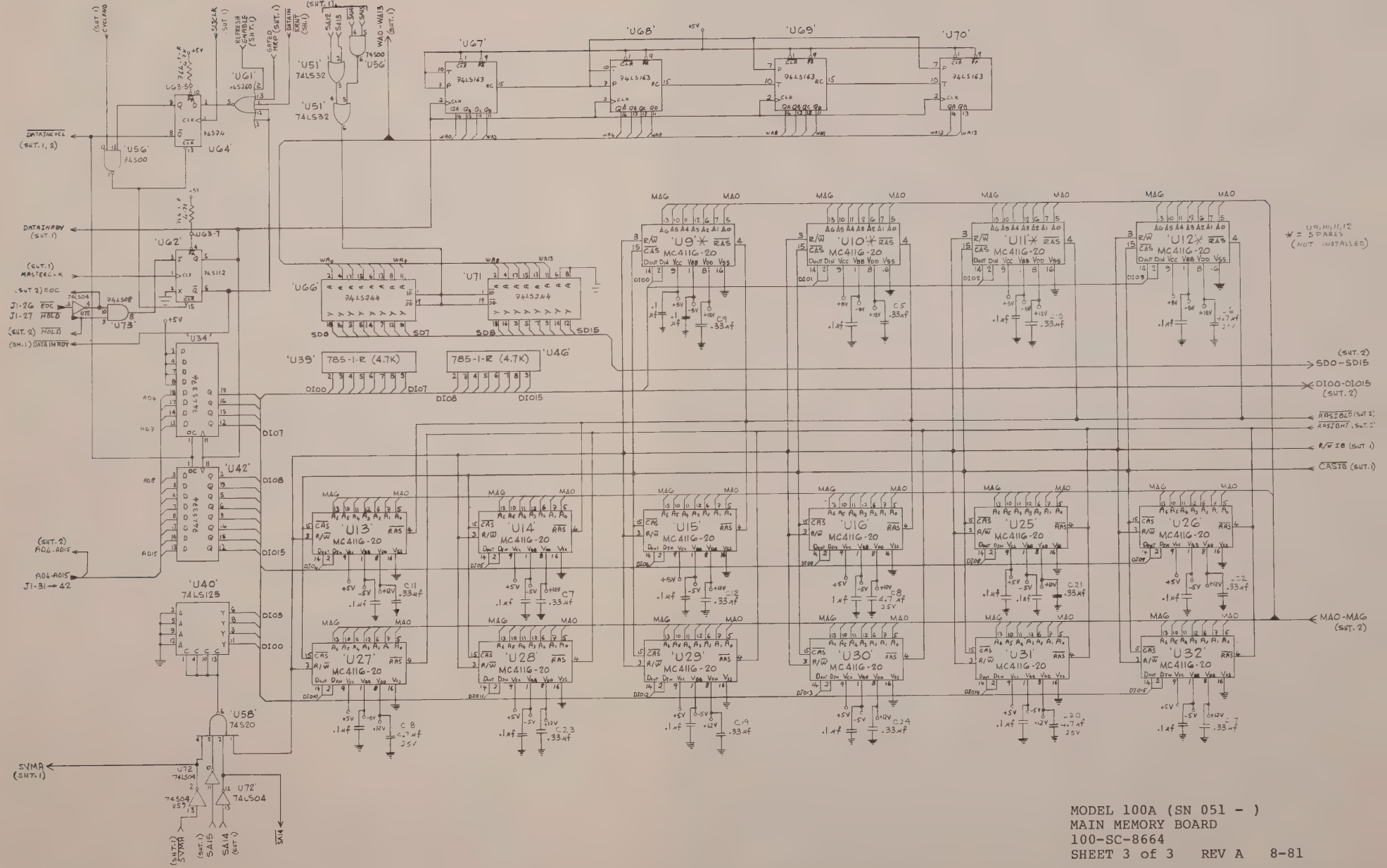
©Nicolet Scientific Corporation 1981


"CONVERTER"
MEM RST
DATA IN CYCL (SH.3)
WA0 - WA13 (SH.3)
BA0 - BA13 (SH.2)
BA14 (SH.2)
CA0 - CA15
SA0 - SA15
HI BYTE EN (SH.2)
LO BYTE EN (SH.2)
SVMA (SHT.3)
SA14 (SHT.3)
(THIS SH.) CA14
(THIS SH.) CA15
SPARE GATES
74LS37 - U102 - 3/4
74S04 - U59 - 1/6
74LS08 - U53 - 1/4
MODEL 100A (SN 051 -)
MAIN MEMORY BOARD
100-SC-8664
SHEET 1 of 3 REV A 8-81
SC-8664
REV E
©Nicolet Scientific Corporation 1981



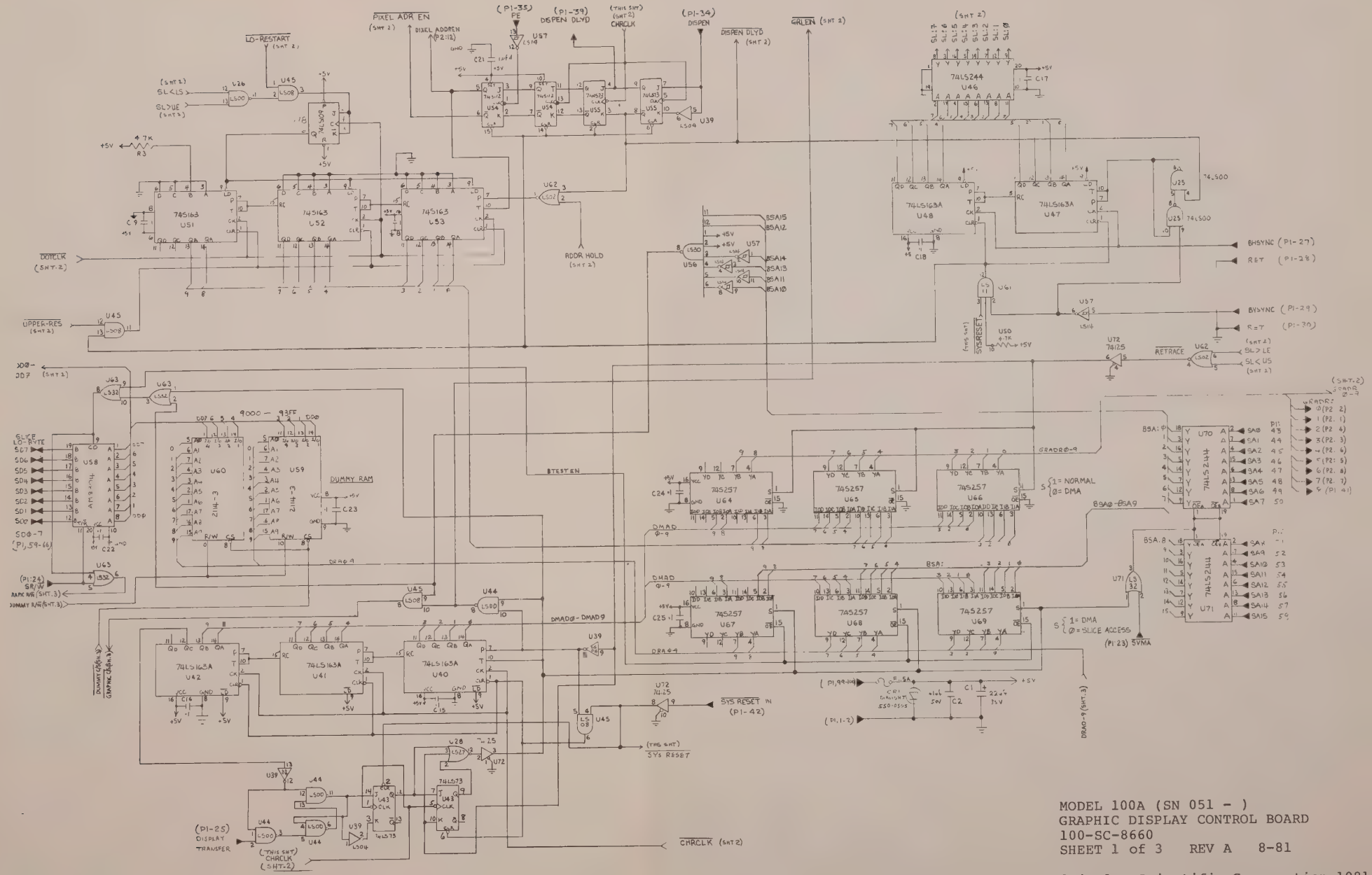
MODEL 100A (SN 051 -)
MAIN MEMORY BOARD
100-SC-8664
SHEET 2 of 3 REV A 8-81

©Nicolet Scientific Corporation 1981



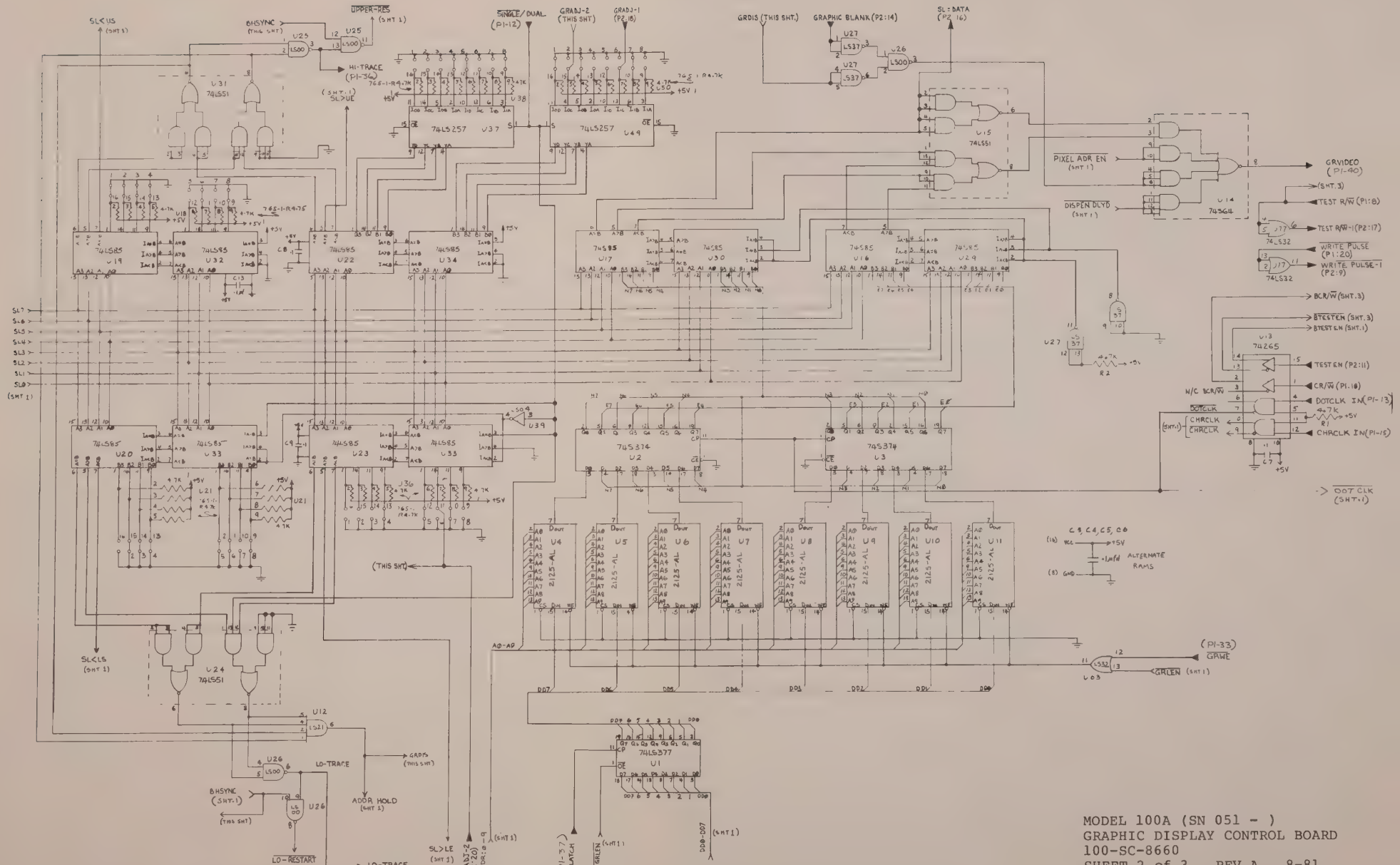
MODEL 100A (SN 051 -)
MAIN MEMORY BOARD
100-SC-8664
SHEET 3 of 3 REV A 8-81

©Nicolet Scientific Corporation 1981



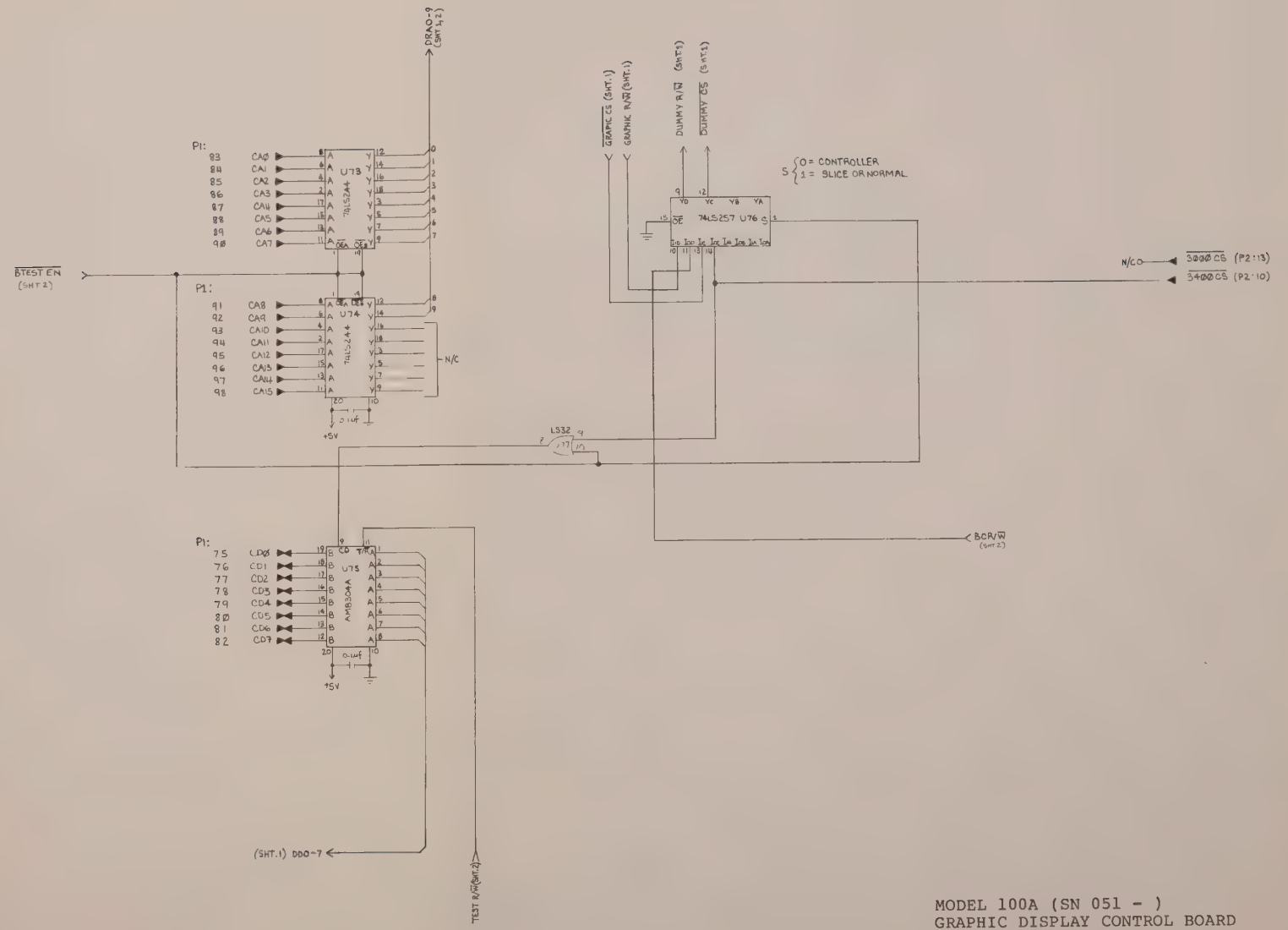
MODEL 100A (SN 051 -)
GRAPHIC DISPLAY CONTROL BOARD
100-SC-8660
SHEET 1 of 3 REV A 8-81

©Nicolet Scientific Corporation 1981



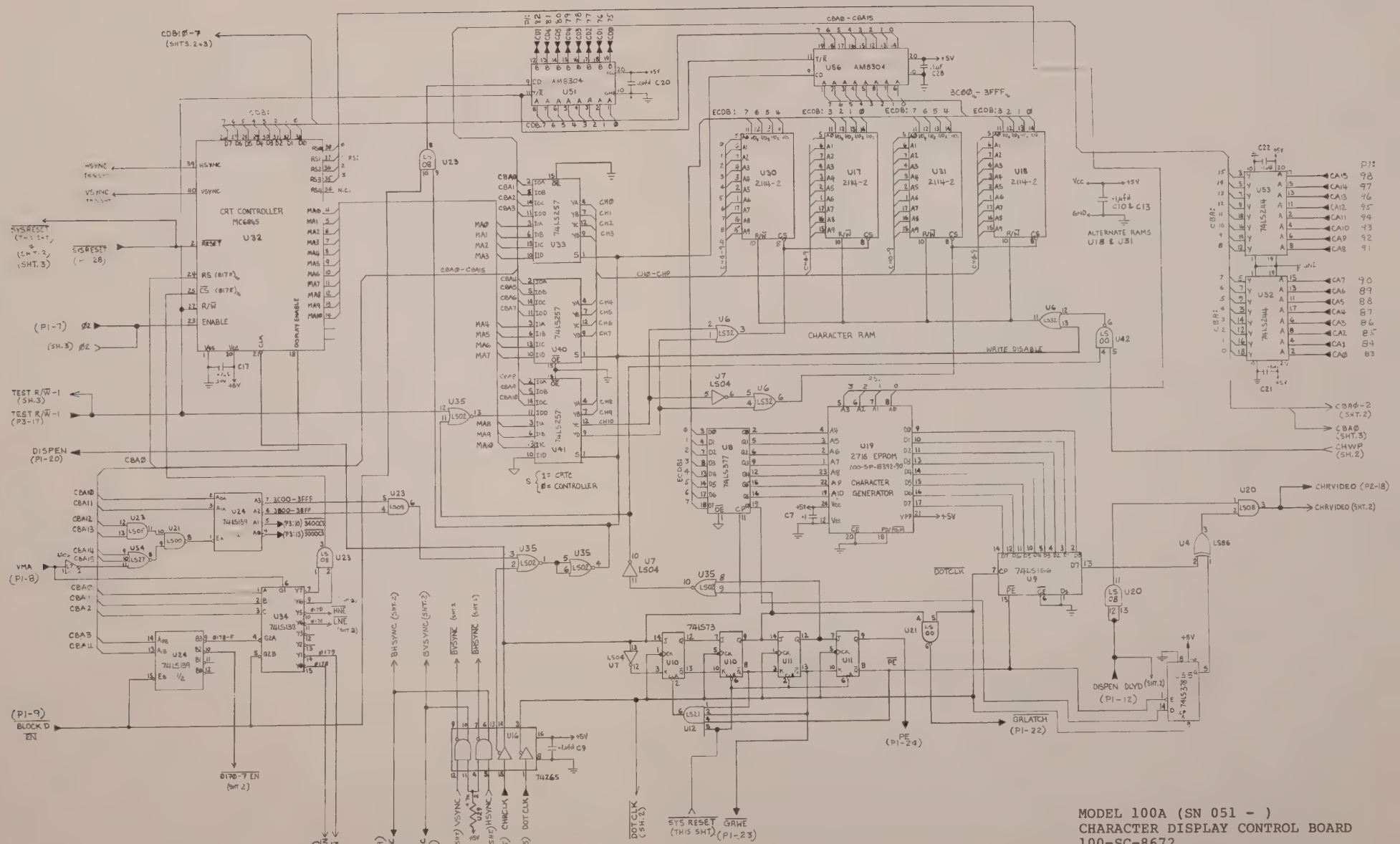
MODEL 100A (SN 051 -)
GRAPHIC DISPLAY CONTROL BOARD
100-SC-8660
SHEET 2 of 3 REV A 8-81

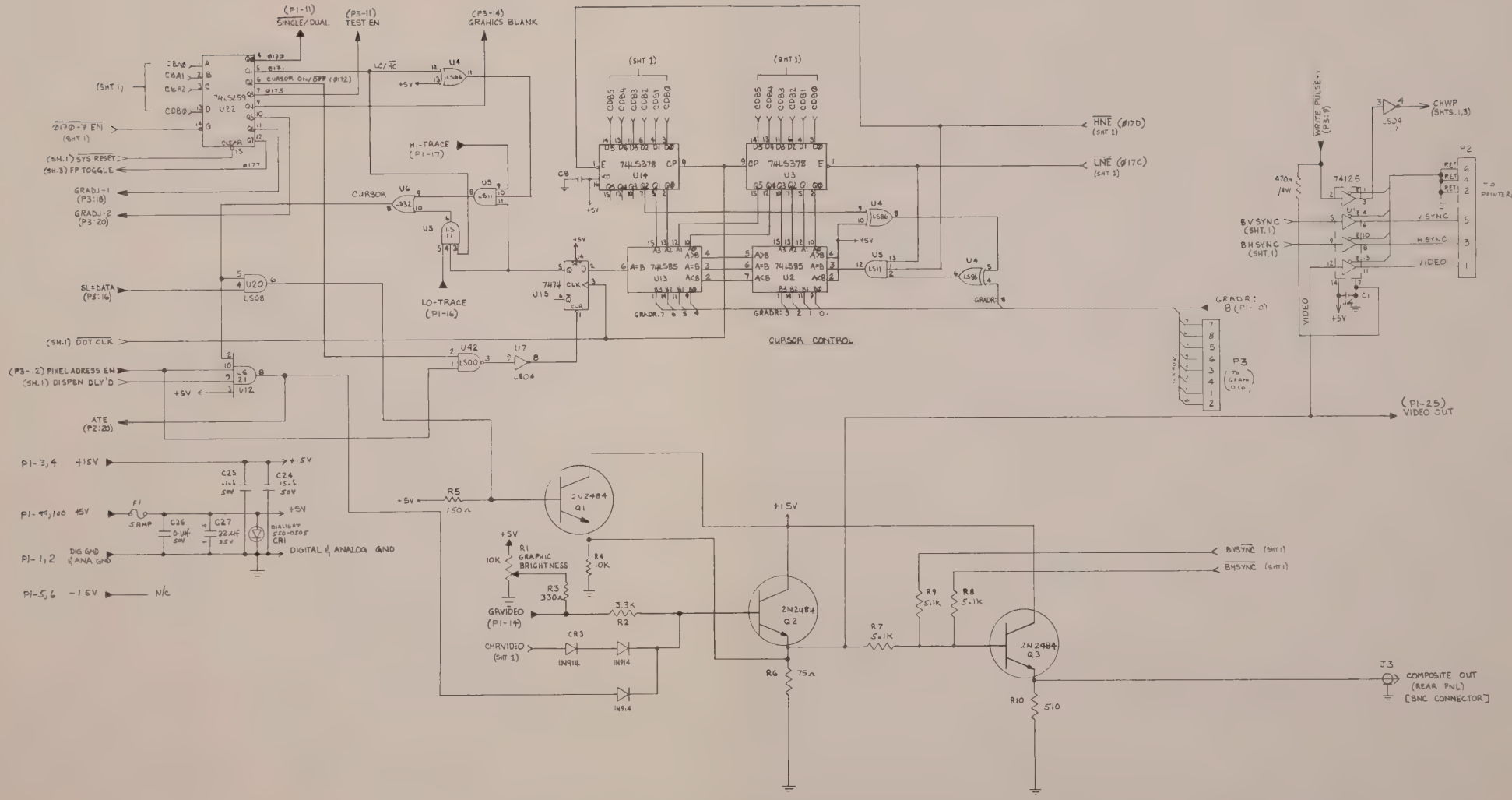
©Nicolet Scientific Corporation 1981



MODEL 100A (SN 051 -)
GRAPHIC DISPLAY CONTROL BOARD
100-SC-8660
SHEET 3 of 3 REV A 8-81

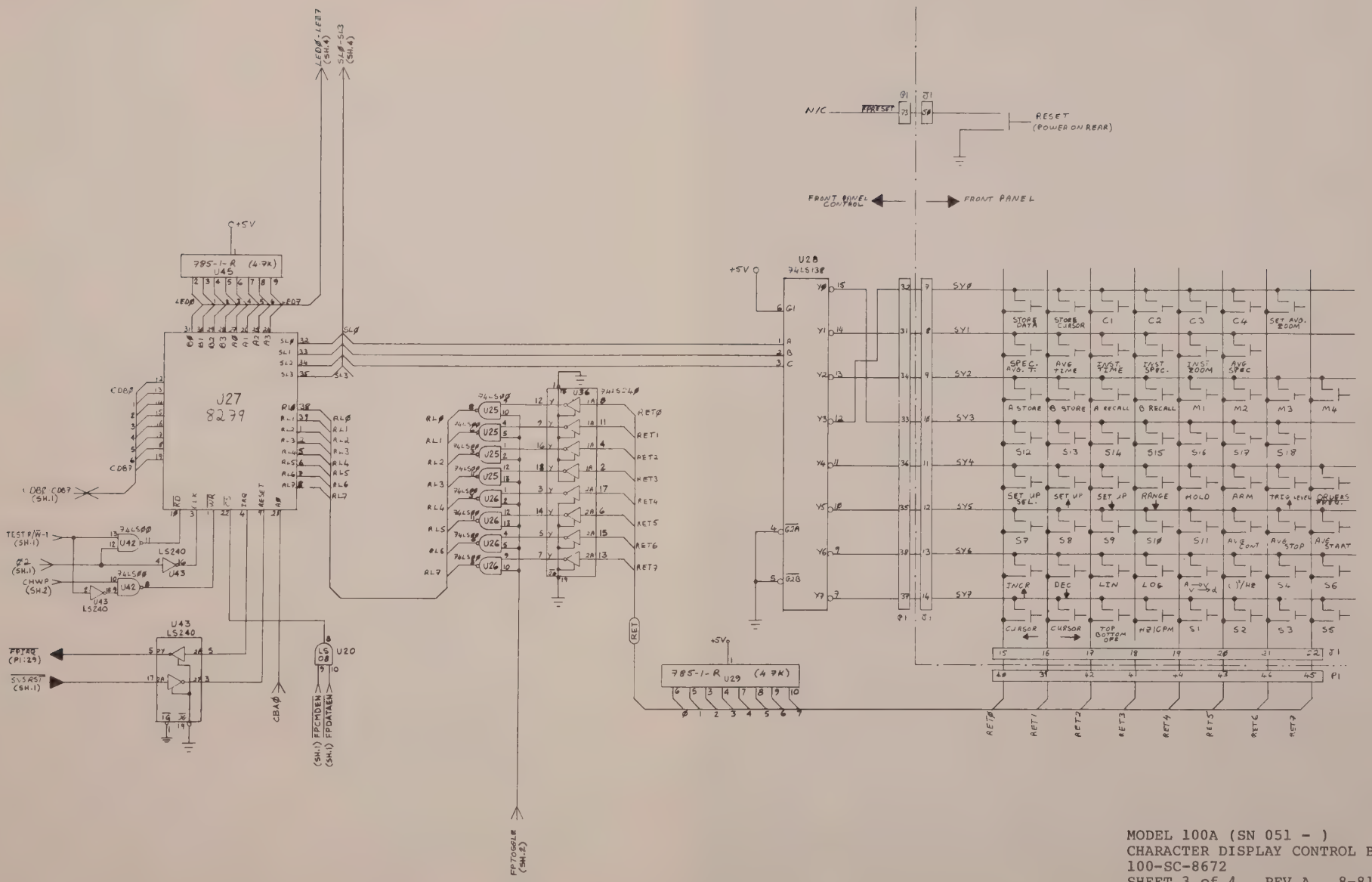
©Nicolet Scientific Corporation 1981


CRT CONTROLLER MC6845 U32
CHARACTER RAM
WRITE DISABLE
ALTERNATE RAMS U18 & U31
2716 EPROM 100-SP-8392-90 CHARACTER GENERATOR
U19
DISPEN (PI-20)
TEST R/W-1 (SH.3)
TEST R/W-1 (P3-17)
VMA (PI-8)
(PI-9) BLOCK D EN
DISPEN DLYD (SHT.2) (PI-12)
GRLATCH (PI-22)
PE (PI-24)
SYS RESET (THIS SHT)
GRWE (PI-23)
DOT CLK (SH.2)
BVSYNC (PI-21)
BHSYNC (PI-19)
CHRVIDEO (PI2-18)
CHRVIDEO (SHT.2)
MODEL 100A (SN 051 -)
CHARACTER DISPLAY CONTROL BOARD
100-SC-8672
SHEET 1 of 4 REV A 8-81
©Nicolet Scientific Corporation 1981



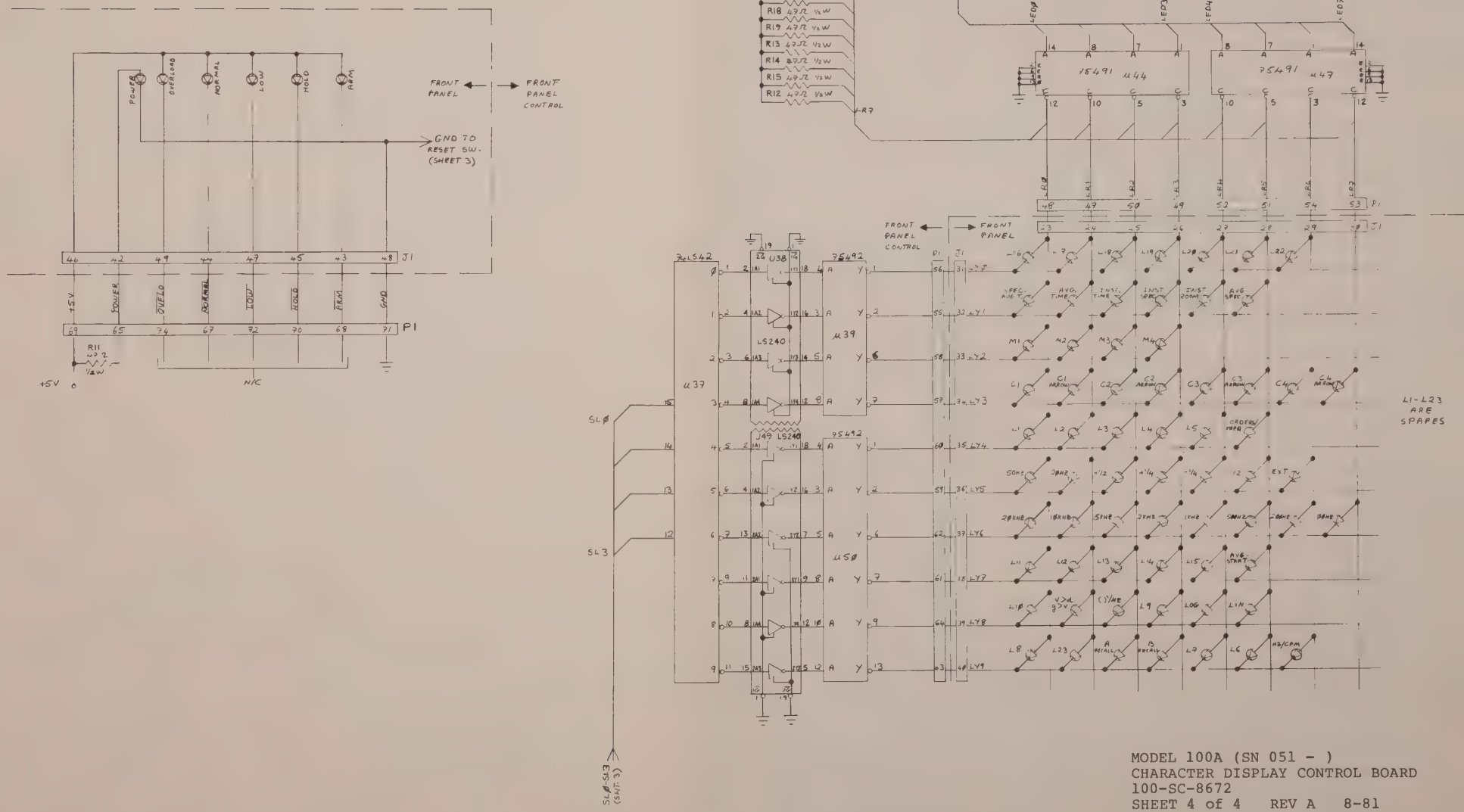
MODEL 100A (SN 051 -)
CHARACTER DISPLAY CONTROL BOARD
100-SC-8672
SHEET 2 of 4 REV A 8-81

©Nicolet Scientific Corporation 1981



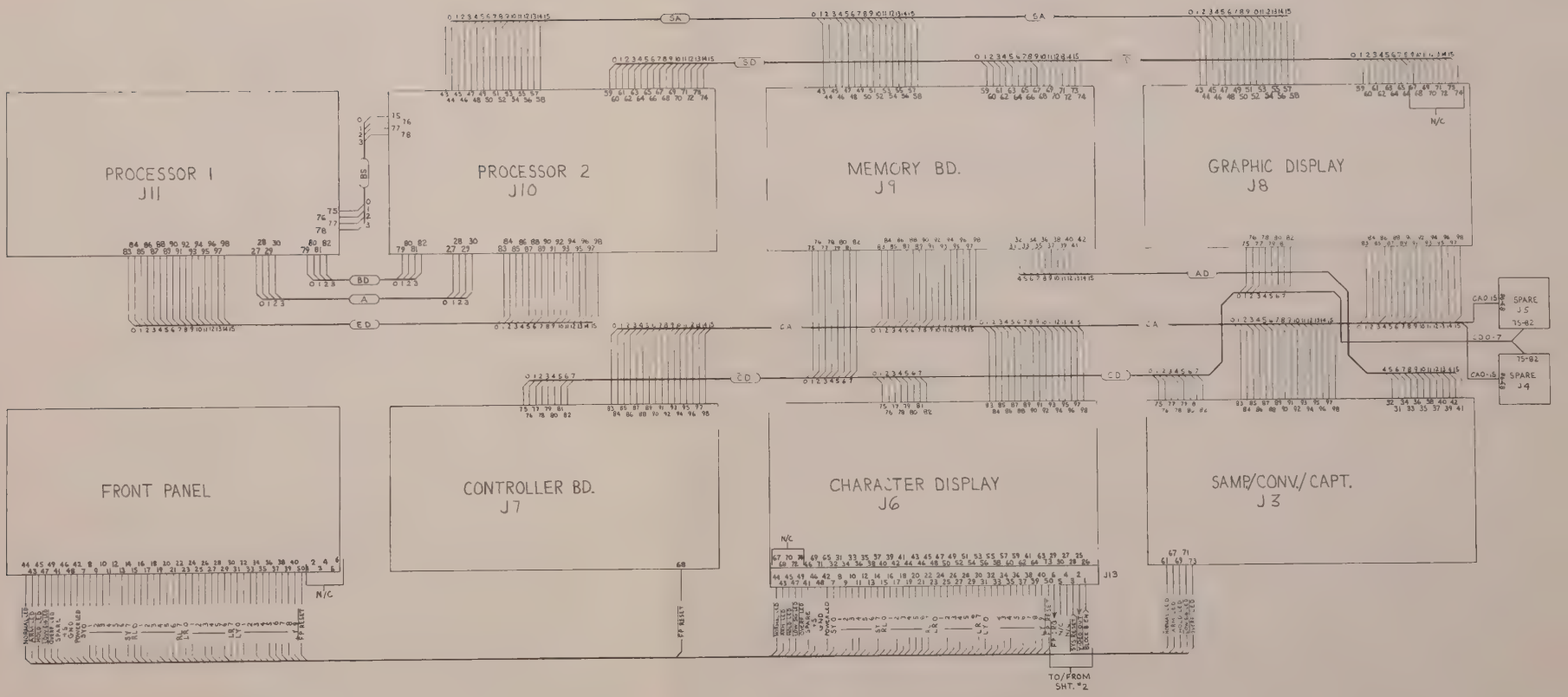
MODEL 100A (SN 051 -)
CHARACTER DISPLAY CONTROL BOARD
100-SC-8672
SHEET 3 of 4 REV A 8-81

©Nicolet Scientific Corporation 1981



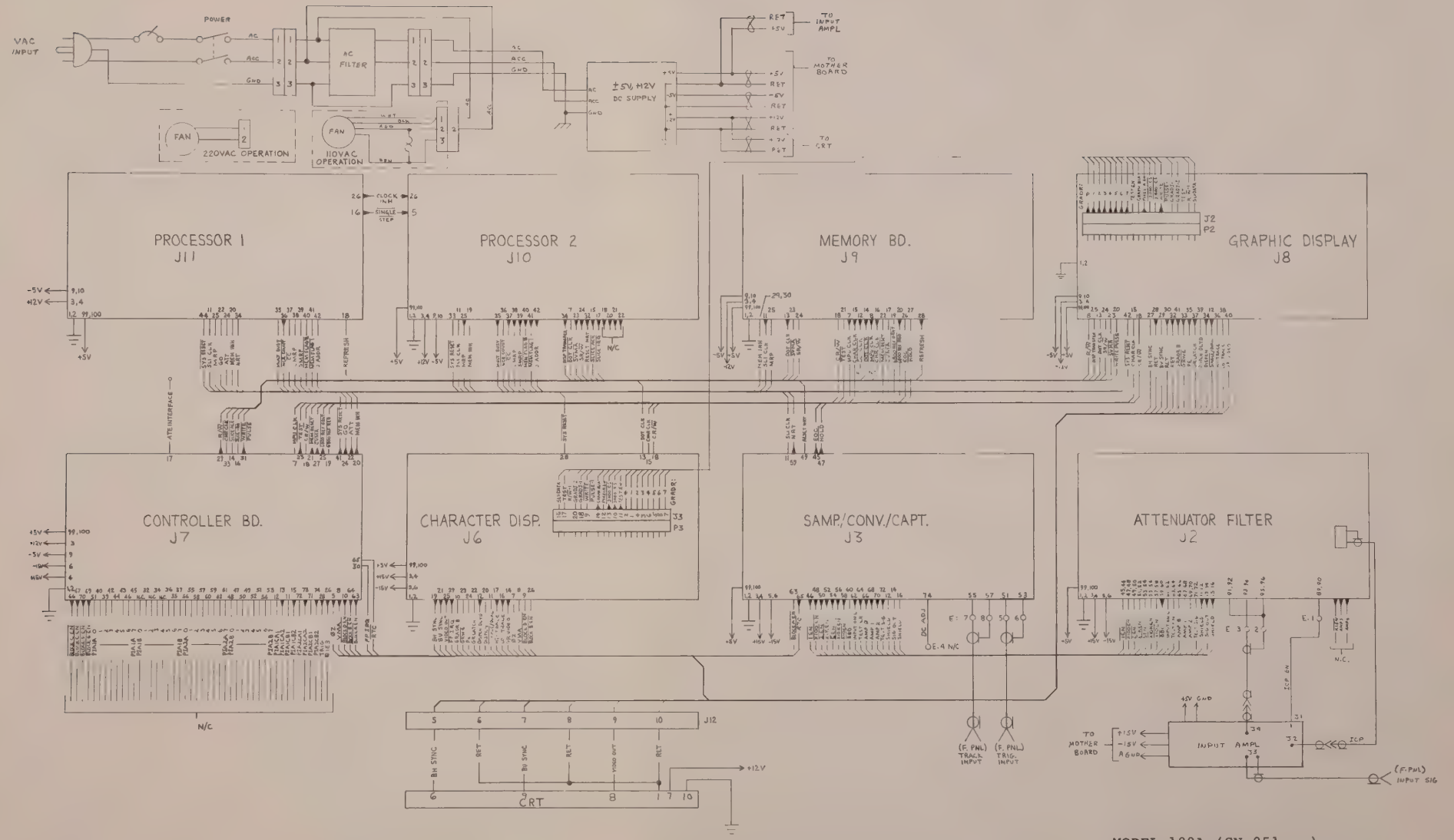
MODEL 100A (SN 051 -)
CHARACTER DISPLAY CONTROL BOARD
100-SC-8672
SHEET 4 of 4 REV A 8-81

©Nicolet Scientific Corporation 1981



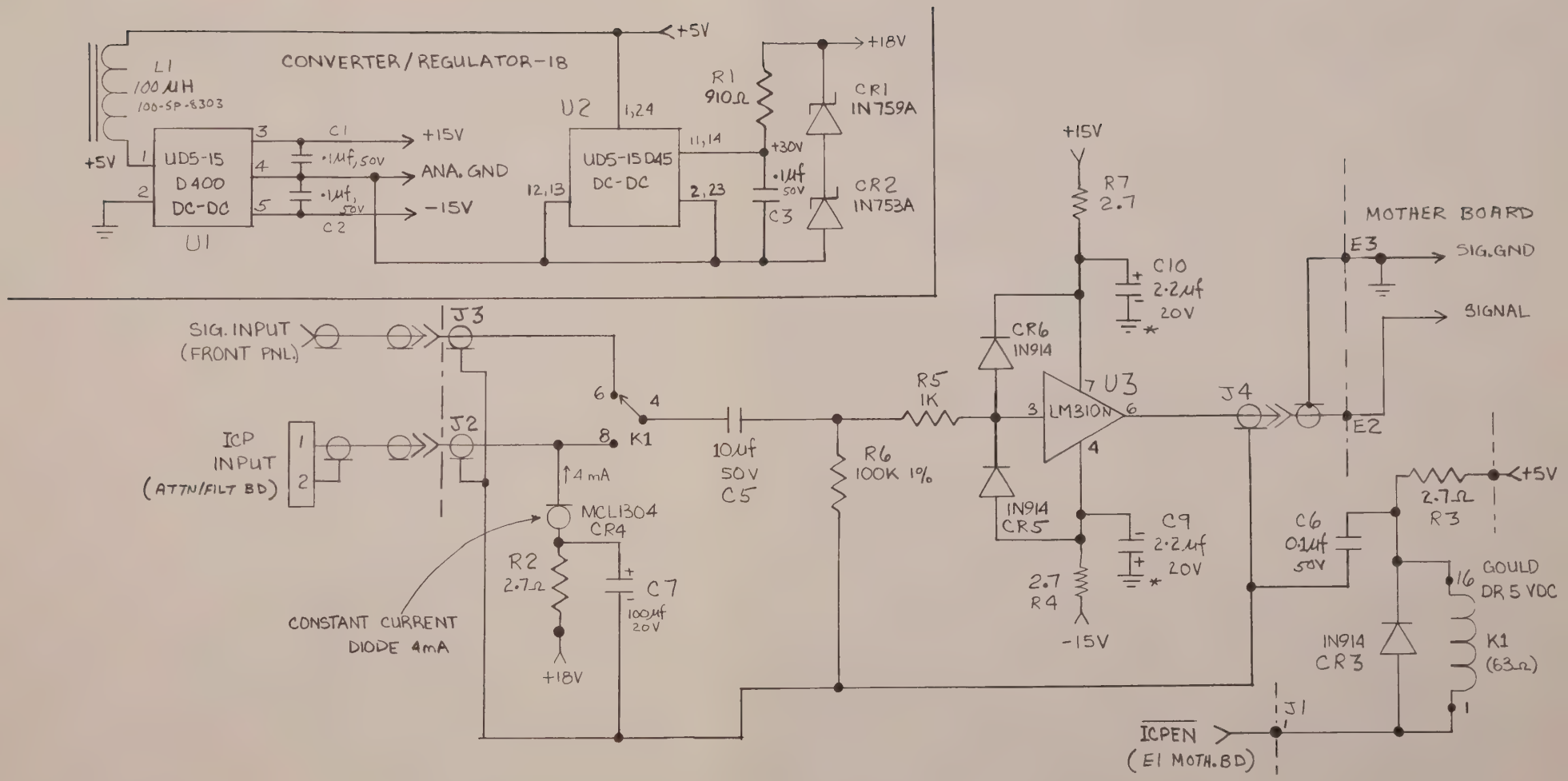
MODEL 100A (SN 051 -)
INTERCONNECTION DIAGRAM
100-SC-8668
SHEET 1 of 2 REV A 8-81

©Nicolet Scientific Corporation 1981



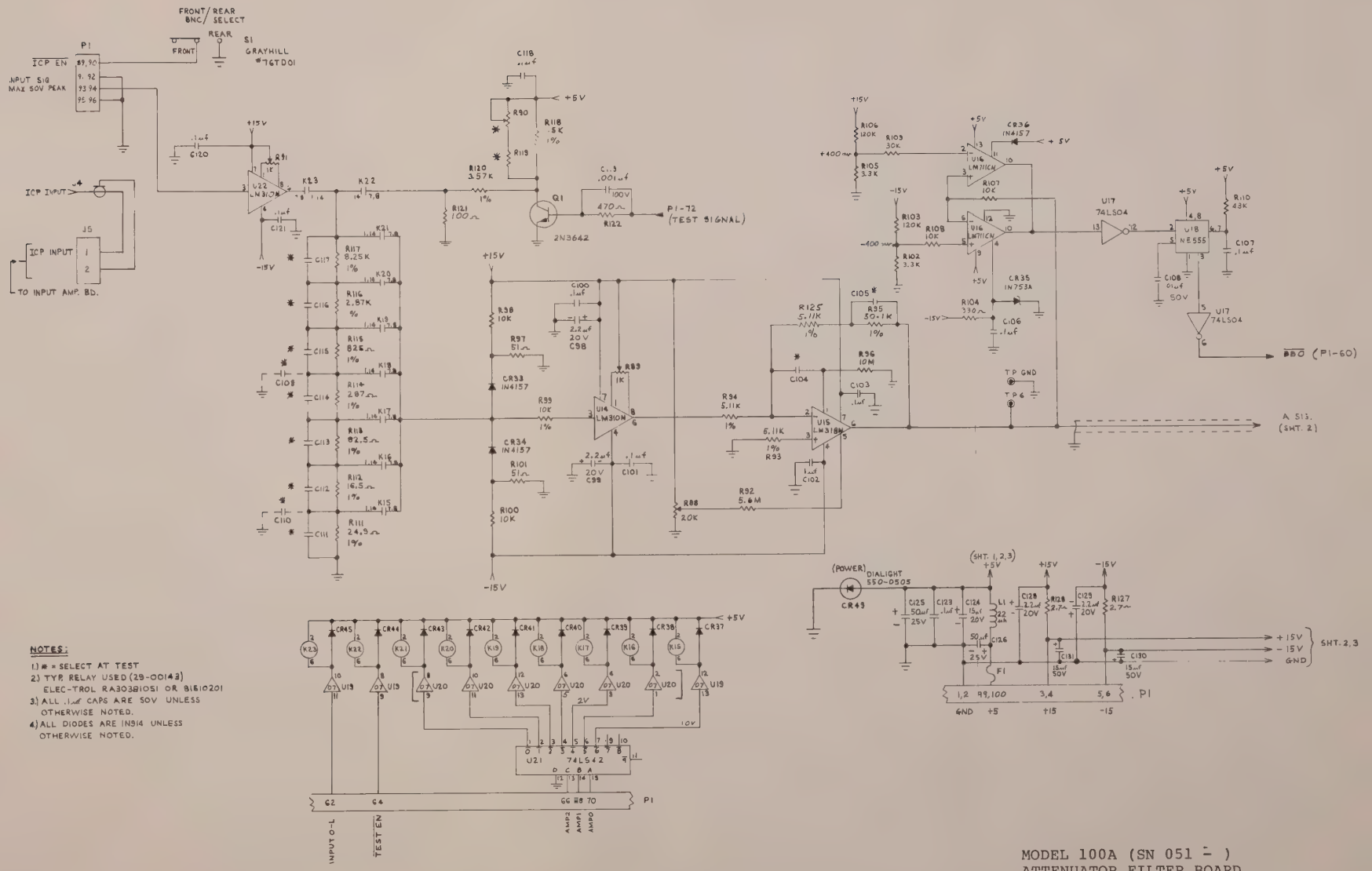
MODEL 100A (SN 051 -)
INTERCONNECTION DIAGRAM
100-SC-8668
SHEET 2 of 2 REV A 8-81

©Nicolet Scientific Corporation 1981



MODEL 100A (SN 051 -)
INPUT AMPLITUDE BOARD
100-SC-8815
SHEET 1 of 1 REV A 8-81

©Nicolet Scientific Corporation 1981

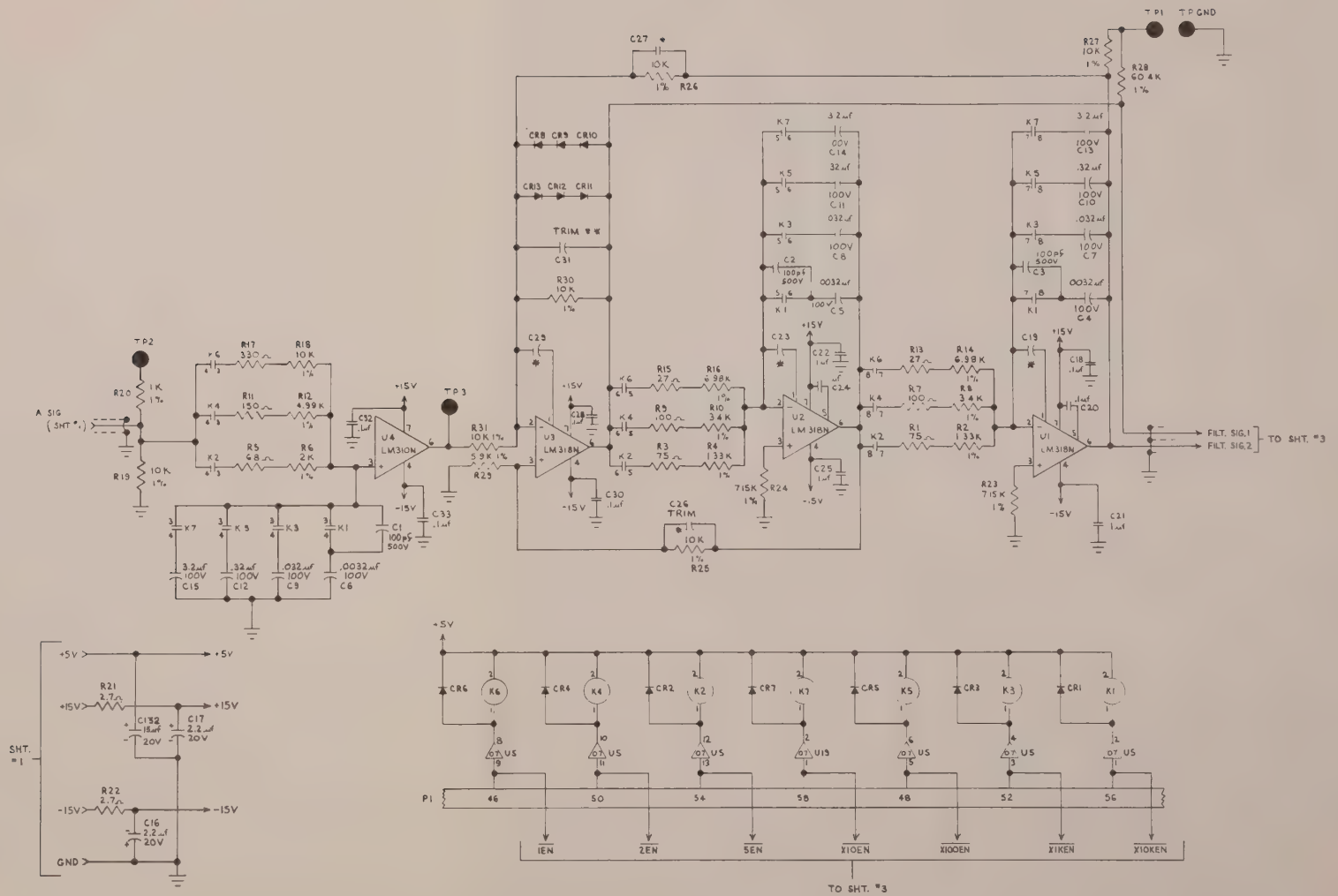


NOTES:

1.) # = SELECT AT TEST
2.) TYP. RELAY USED (29-00142) ELEC-TROL RA3038I05I OR B1610201
3.) ALL .1uf CAPS ARE 50V UNLESS OTHERWISE NOTED.
4.) ALL DIODES ARE IN914 UNLESS OTHERWISE NOTED.

MODEL 100A (SN 051 -)
ATTENUATOR FILTER BOARD
100-SC-8666
SHEET 1 of 3 REV A 8-81

©Nicolet Scientific Corporation 1981

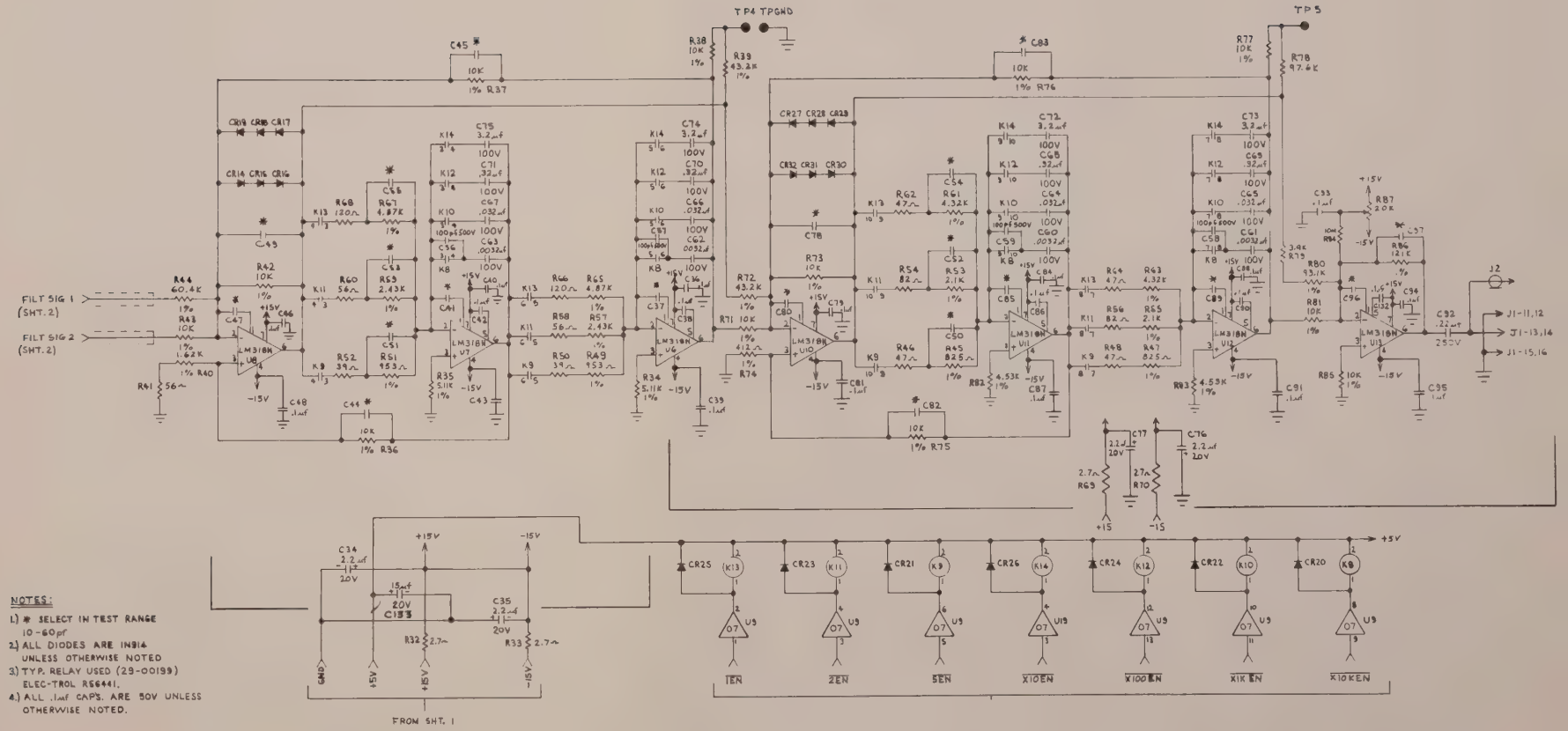


NOTES.

1.) * SELECT AT TEST
2.) ** SELECT IN TEST RANGE 1 TO 30 pf
3.) ALL DIODES ARE IN914 UNLESS OTHERWISE NOTED.
4.) TYP. RELAY USED (29-00180) RELAY ELEC-TROL R56431
5.) ALL .1 mf CAP'S. ARE 50V UNLESS OTHERWISE NOTED.

MODEL 100A (SN 051 -)
ATTENUATOR FILTER BOARD
100-SC-8666
SHEET 2 of 3 REV A 8-81

©Nicolet Scientific Corporation 1981

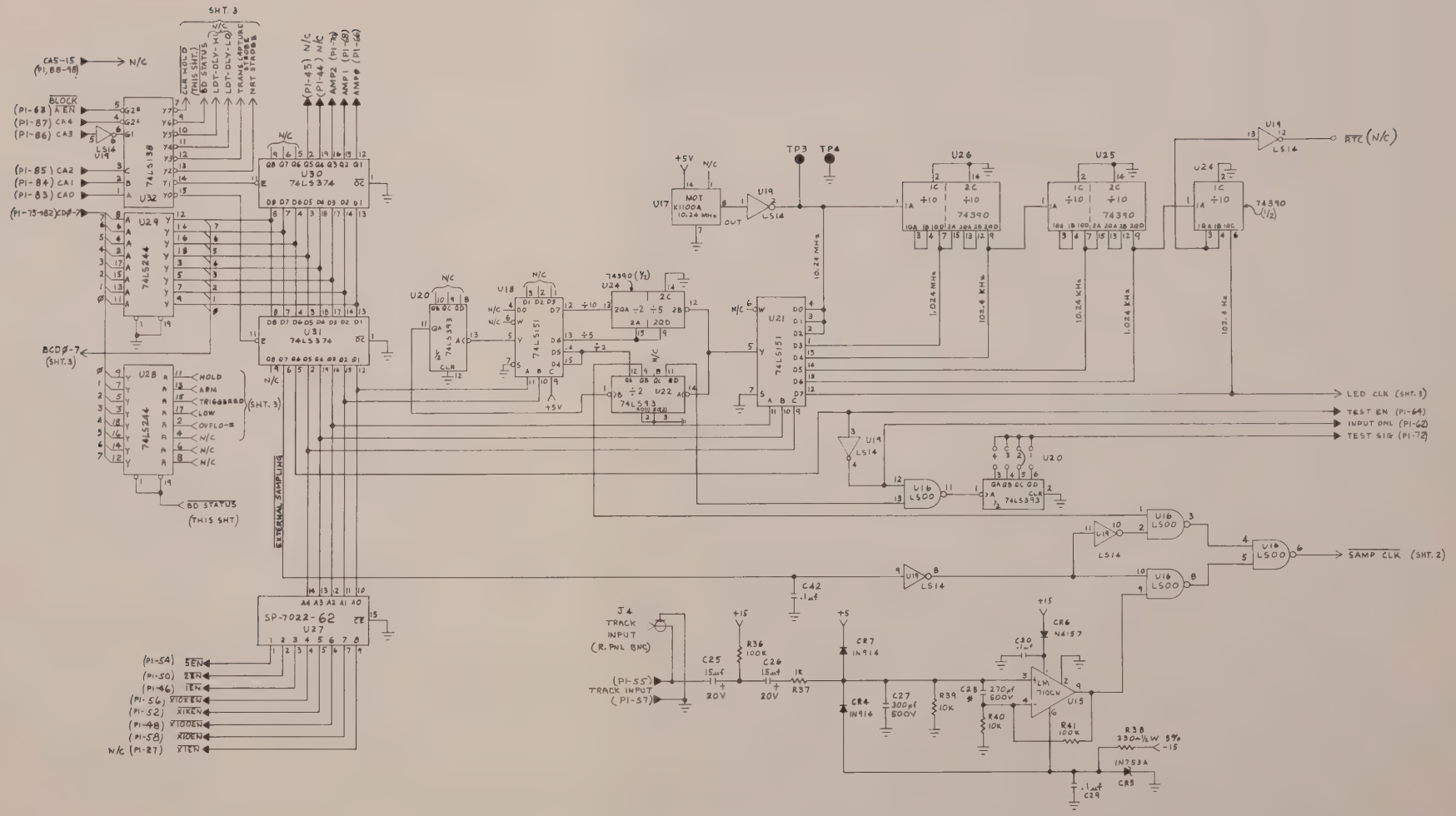


NOTES:

1.) # SELECT IN TEST RANGE 10-60pf
2.) ALL DIODES ARE IN914 UNLESS OTHERWISE NOTED
3.) TYP. RELAY USED (29-00199) ELEC-TROL RS6441.
4.) ALL .1mf CAP'S. ARE 50V UNLESS OTHERWISE NOTED.

MODEL 100A (SN 051 -)
ATTENUATOR FILTER BOARD
100-SC-8666
SHEET 3 of 3 REV A 8-81

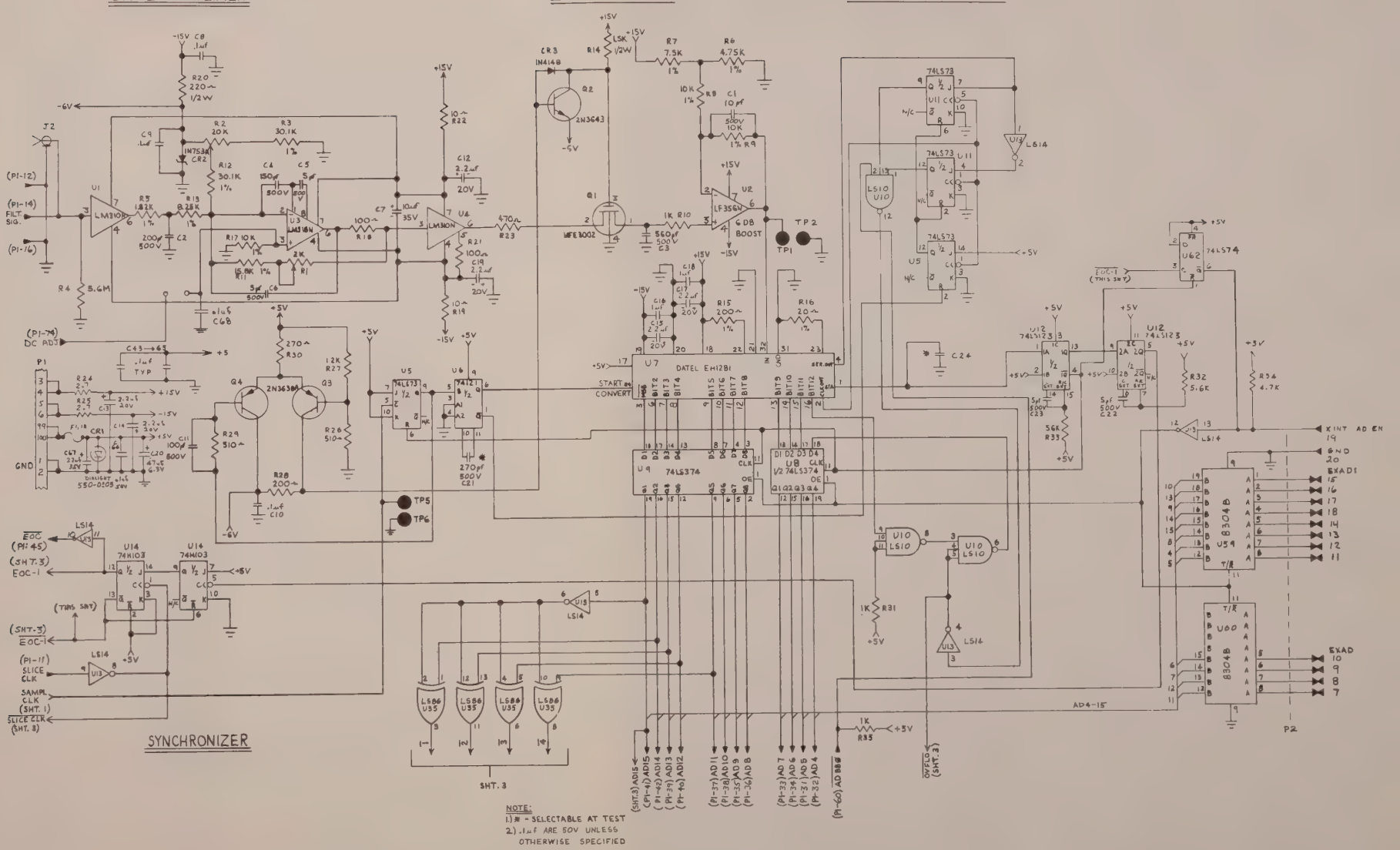
©Nicolet Scientific Corporation 1981



NOTES:
1. ALL .1uf CAPS ARE 50V UNLESS OTHERWISE NOTED.

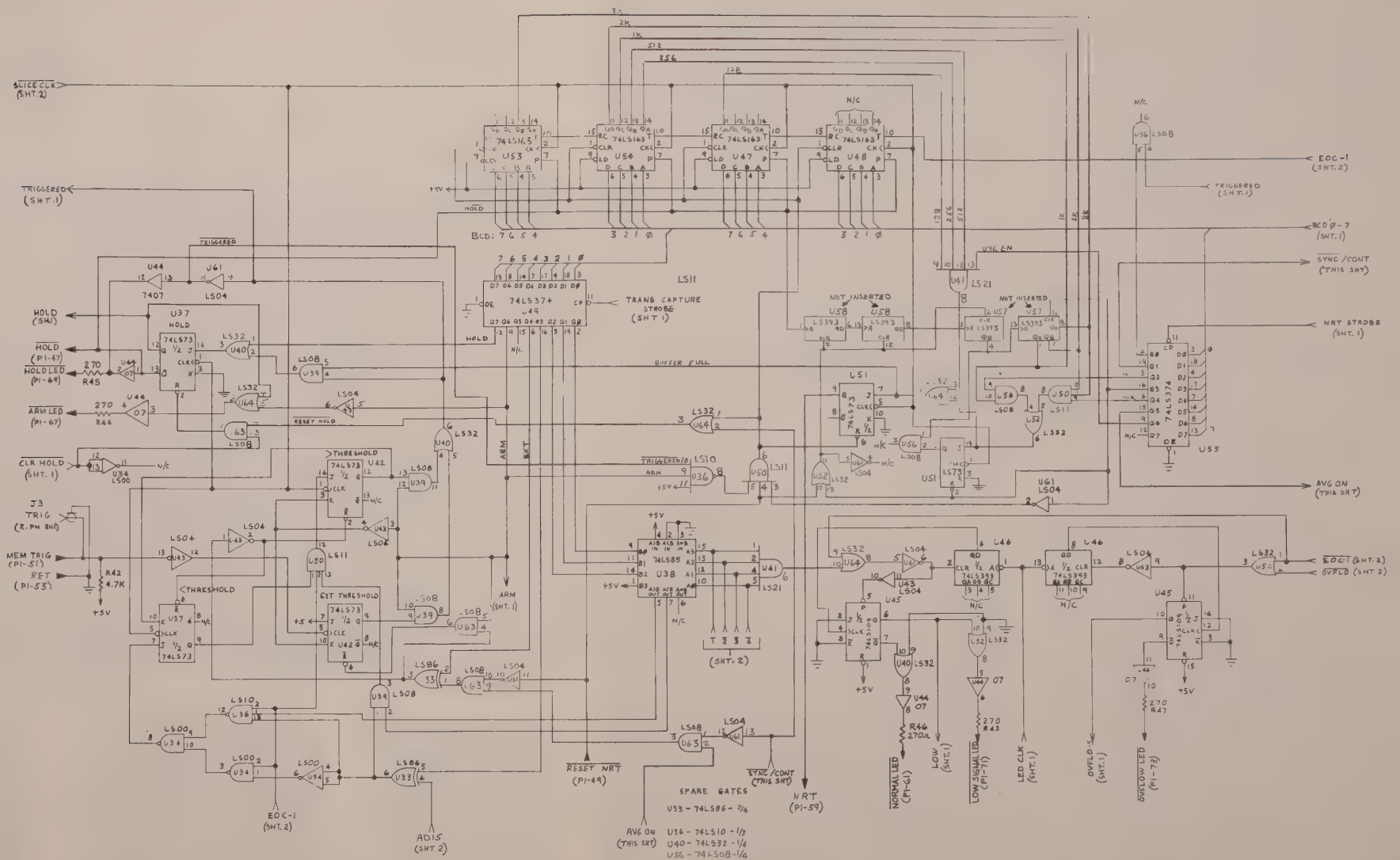
MODEL 100A (SN 051 -)
SAMPLING/CONVERTER/CAPTURE BOARD
100-SC-8665
SHEET 1 of 3 REV A 8-81

©Nicolet Scientific Corporation 1981



MODEL 100A (SN 051 -)
SAMPLING/CONVERTER/CAPTURE BOARD
100-SC-8665
SHEET 2 of 3 REV A 8-81

©Nicolet Scientific Corporation 1981



MODEL 100A (SN 051 -)
SAMPLING/CONVERTER/CAPTURE BOARD
100-SC-8665
SHEET 3 of 3 REV A 8-81

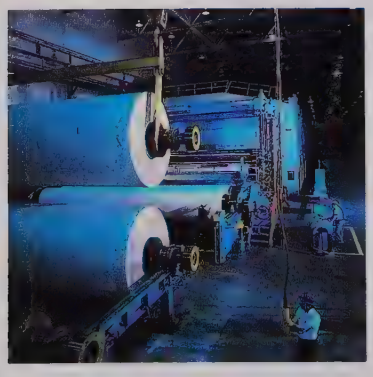
©Nicolet Scientific Corporation 1981

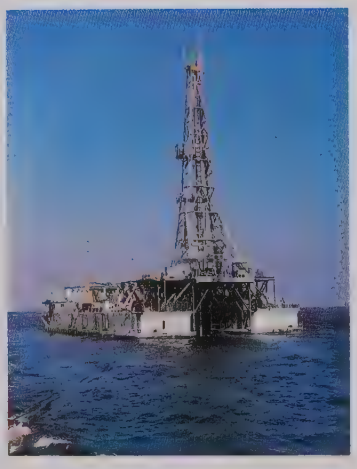
model
100A

MINI-ANALYZER

...a unique instrument
for vibration and noise
analysis on-site

machine health diagnosis
product evaluation
production test





NICOLET
SCIENTIFIC
CORPORATION
A NICOLET INSTRUMENT SUBSIDIARY

NICOLET'S EXPERIENCE CAN HELP YOU UNDERSTAND YOUR MACHINE'S VIBRATION

In 1965 Nicolet Scientific Corporation (then known as Federal Scientific) designed the first digital real-time analyzer, called the "Ubiquitous" spectrum analyzer. Since then, Nicolet has been a world leader in vibration and noise analysis. Suggestions from thousands of users over the years have helped make Nicolet analyzers the easiest to learn and use, while improving their flexibility to handle a variety of problems.

The MINI-Analyzer is Nicolet's tenth generation analyzer. It is the result of the experience of many hundreds of Nicolet users in petro-chemical processing, paper manufacturing, power generation, vehicle manufacturing and other industries concerned with machine maintenance, field testing and production. Insight into the needs of the person, who must decide when and what machine maintenance is necessary has also come from Nicolet's own **Machinery Vibration Consultants.** This group has years of practical on-site experience on contract to a wide variety of industries in setting up preventative maintenance programs, diagnosing machine vibration and running in-plant machine health training programs.

Nicolet's Machine Vibration Consultants are available to aid in setting up machine diagnostic programs or for in-plant training courses in recognizing machine problems before they become catastrophes and in applying the 100A most effectively. Contact the factory for a proposal.

INTRODUCING NICOLET'S MINI-ANALYZER....a new concept in on-site frequency analysis

Previously, frequency spectrum analyzers were designed for research and therefore were complicated and difficult to operate with a display that was hard to understand. The Nicolet Mini-Analyzer - based on the experience of thousands of Nicolet Analyzers produced over almost 20 years - is unique in that it is specifically designed to be....

(1) Easy to learn and use
(2) Lightweight to take to the test site
(3) Powerful enough to solve almost every problem
(4) Affordable by virtually every facility

What does VIBRATION ANALYSIS tell about MACHINE HEALTH?

When a machine begins to wear, almost invariably its vibration increases. A single "overall" measure of the total vibration will then rise. However, the rise may be very small. This is because each different mechanism in the machine produces its own vibration. If only one of many sources of vibration increases, its effect on the total measured vibration may be slight, so slight **it may not be noticed.**

Each of the mechanisms in a machine has its characteristic pattern of vibration or "signature". This pattern is easiest to recognize by the frequencies it contains. A rotating shaft vibration will probably be dominated by the fundamental rotation frequency (RPM) and multiples or harmonics of it; a gear vibration pattern will contain a lot of energy at the tooth mesh frequency.

To recognize a vibration frequency and relate it to the mechanism that produces it requires an instrument that separates each frequency of vibration from the others. The more separate frequencies it recognizes (resolution) the better it is able to distinguish one problem from another.

The Nicolet MINI-Analyzer is called a "spectrum analyzer" (or more correctly a "frequency analyzer") since it gives the user a spectrum composed of many individual frequencies. Since it operates very rapidly - as rapidly as possible - it is called a "real-time" analyzer. Because it uses modern digital computer-like circuits to perform this fast analysis, it is called a Fast Fourier Transform analyzer, or "FFT analyzer).

An FFT analyzer, such as the Nicolet MINI-Analyzer, rapidly produces a picture not only of the original time-varying vibration pattern, but of its spectrum or frequency pattern. Slight changes at **one** of hundreds of frequency peaks can be detected and provide early warning that something is going wrong in the machine, even though the **total** vibration energy does not appear to have changed.

The identification of **which** frequencies are present provides the operator with a key to what part of the machine is vibrating most. Changes in the **amount** of vibration can be detected early. Frequency analysis is, therefore, a powerful tool in recognizing vibration change and identifying its source.

In MAINTENANCE, frequency spectrum information is vital in deciding if a detected malfunction warrants shutdown of the machine immediately or if it can operate until a more convenient time (allowing early procurement of replacement parts). Frequency analysis with Nicolet's MINI-Analyzer can prevent major damage to the machine, excessive production loss and danger to personnel.

In PRODUCTION, a standard for acceptance can be established based upon the vibration or noise spectrum from Nicolet's MINI-Analyzer which relates to the quality of the product and therefore its saleability. Causes for rejection can be identified from the pattern of frequencies, allowing manufacturing processes to be refined to increase yield and rejected products to be fixed and made acceptable. The MINI-Analyzer can be used by unskilled operators for repeated tests with simple interpretations.

In PRODUCT TEST, frequency analysis with Nicolet's MINI-Analyzer can tell if operation is satisfactory and if not, what mechanism needs improvement. If noise is excessive, its causes can be traced by frequency spectrum analysis. The MINI-Analyzer is designed to provide flexible analysis for a variety of problems virtually anywhere in the lab or field.

In MACHINE START-UP, frequency analysis with Nicolet's MINI-Analyzer can identify resonances at critical speeds, evaluate their seriousness and provide the basis for installation changes. Optimum running speed for long life may be determined, and increased running speed (for increased production) can be verified to be safe.

How the MINI-Analyzer makes problem-solving easier

Insures Correct Data Interpretation With Minimal Training

- Fast simple annotated displays and recordings....clearly marked scales, calibration, ID record numbers and complete grids....are produced.
- Accelerometers with their inherent wide frequency coverage can be used and yet measurements can be made in familiar units of velocity (in/s or m/s)....if an easy-to-apply velocity pickup is used, readings can be in familiar displacement units (mils or micrometers)....conversion of measurements to power spectral density (PSD) is made with the push of a button.
- Unique **phase** readings separate shaft bending, loose mountings or misalignment from unbalance.

Provides Valid and Repeatable Measurements

- Regardless of speed, stable frequency readings can be made in terms of orders of rotation.
- Overloads **within** the band of analysis are separated from those **outside.**
- Time waveforms can be viewed at the same instant as frequency....or the entire band **and** a zoom expansion of a small region of it can be simultaneously viewed.
- 12 specific measurement frequencies are memorized in the unit so that they can be repeated exactly again and again, even when power is turned off and on again.
- 3 complete control setups and calibrations are stored, even when power is turned off....power turn-on automatically restores all settings and calibrations that were being used when the unit was turned off.
- Simple (summation) or on-line (exponential) averaging smooths random spectrum variations....peak profiles retain maximum energy at each frequency.

Identifies Separate Signal Sources Even When Close In Frequency
(transmissions or different machines running at nearly the same speed)

- High basic 400-line frequency resolution can be increased 10 times by built-in zoom expansion....from a **4000-line** spectrum.
- High resolution zoom scan is controlled by the cursor, as viewed simultaneously on the display of the entire frequency range.

Separates The Signature of One Mechanism or Event Masked By Others

- Time averaging, synchronized with the signal of interest, enhances it while reducing all other signals.
- If machine speed varies, analysis synchronized with shaft rotation produces the true spectrum of shaft vibration, while other vibration data is reduced.

Recognizes Changes By Comparing Signatures
(resonances at particular speeds, the effects of loading or radial vs. axial measurements)

- Four separate spectra are stored for reference. Any two can be displayed at once or any one can be displayed simultaneously with new spectra.
- 12 specific frequencies (cursors) and/or zoom expansion band locations are stored for precisely repeatable measurements that allow direct comparisons.
- Speed-normalized spectra can be directly compared, even when measured at different speeds.

Minimizes Time To Get Answers

- Repeated, time-consuming zoom is eliminated by the use of **zoom scan** of the 4000-line spectrum, or by averaging four zoom bands **and** the basic spectrum all at once.
- High speed analysis gives results in seconds (not minutes).
- Simple hardcopy unit prints annotated records quickly without paper setup.

Balances In Place With No Added Equipment

- Unique phase reading on spectra of rotation vibration requires only **one** trial weight test to establish size and position of the balance weight required (with no extra balance analyzer needed).

Analyzes Transients Easily
(impacts, sudden out-of-normal impulses)

- Transient events are automatically held in a digital memory for careful visual examination and measurement in time or frequency.
- The highest instant spectrum profile readings are retained, regardless of when they occur (peak "averaging").
- Simultaneous display of time **and** frequency provides two important views of the same signal.

SPECIFICATIONS FOR MODEL 100A..

INPUT

Sensitivity: Full scale 100 mv to 10V (0-P), 10 dB (~ 3:1) steps.

Impedance: 100 Kohms

Coupling: AC, -3 dB at 0.2 Hz; ± 50 V peak max.

Accelerometer Power: Rear input includes 4 ma for ICP.

Amplitude Indicators: Overload light for in-range (digital) and out-of-range (analog) overload; low indicates input below -24 dB (1/8 FS) and NORMAL light if input between FS and -24 dB.

Filtering: Anti-aliasing filters on each range, 120 dB per bandwidth octave rolloff to -60 dB; ± .5 dB response

Sampling: Internal at 2.56 times maximum frequency in the analysis range; external TTL sampling input 51.2 kHz maximum.

ANALYSIS

Baseband: 0-20 Hz (1200 CPM) to 0-20,000 Hz (1200 kCPM).

Zoom: Any 10% of the baseband range, selected as ±5% about cursor during or after 10,000-sample memory load.

Resolution: 400 resolution elements in baseband or zoom spectrum.

Dynamic Range: Over 60 dB (12 bits).

Weighting: Hanning or flat (uniform).

AVERAGING

Type: For frequency, 400 resolution elements as sum, exponential or peak profile. For time, 1024 sample linear average.

Number: 1, 4, 16, 64, 256

Calculation: Power averaging with readout in linear units.

Zoom: From 1 to 4 preset frequency zoom bands plus one baseband spectrum can be averaged and stored simultaneously, each of 400 lines.

STORAGE

Data: Any four displays or zoom averages can be stored in four 400-line (volatile) memories on command.

Cursor Location: Four cursor locations can be stored in a non-volatile memory (C1, C2, C3 and C4). In addition, panel storages A and B each retain four cursor locations in their **non**-volatile memories; stored cursors can be used to set zoom bands to be averaged or can be recalled to the display.

Panel: Three complete control setup states - PANEL A, PANEL B and the current panel active at the time power is turned off - are retained in **non**-volatile memories; each setup includes all annotation (ID #, calibration, display gain, conversions, etc.) as well as four stored cursors and the type of data display.

DISPLAY

Size: 5" diagonal

Type: Raster scan, refreshed 60/sec

Data: Instant or averaged display of time, baseband frequency or zoom frequency displayed singly or in pairs; any data display can be stored in any of four 400-word memories and the contents of the memory displayed singly or as a dual display with any other display.

Vertical Scales: Linear, five divisions with X2 gain steps to X512 active on trace with cursor; log 60 dB or 120 dB full scale selectable for spectra.

Horizontal Scale: Linear time or frequency.

DISPLAY ANNOTATION

Current Setup: (set with SETUP keys)

- 4-digit ID number
- Input sensitivity
- Averaging type
- Averaging number
- Amplitude calibration

Data Display: (stored with data)

- Averaging type and number
- Left (minimum) edge of graticule (in Hz or sec)
- Right (maximum) edge of graticule (in Hz or sec)
- Top of graticule (in same units as sensitivity calibration)
- Type of data display or memory in which stored (M1, M2, M3 or M4)

Cursor Measurement: Reads amplitude, horizontal position, and phase.

AMPLITUDE CALIBRATION

Units: Consistent for setup, data scale and cursor in g(0-P) for time or g(P-P) for frequency, in/s(0-P) or M/s(0-P), in (P-P) or M(P-P), V(0-P) or EU(0-P) where "EU" is any engineering unit; selection of g(E) or g(M) determines English or Metric units.

Cursor Unit Conversions:

- Acceleration g(0-P) to velocity (0-P), in/sec or M/s
- Velocity (0-P) to displacement (P-P), in or m
- Any unit to (units)^2/Hz, e.g. g to g^2/Hz (PSD)

Calibration Constant: Scale adjustable from .01 to 999 mv/unit and and 1 to 999 V/unit.

CURSOR MEASUREMENTS

Amplitude: Linear units of calibration with conversions; log dBV.

Phase: Valid for phase change on two inst. spec., inst. zoom, or spec. avg. t.

Horizontal: Hz, CPM, sample number or sec (from left edge of display, which is "earliest" time sample).

TRANSIENT HOLD

Auto: If ARM has been pushed, 1024 samples are collected and held in memory after the trigger source reaches the preset trigger level.

Manual: Last 10K samples are held in memory when HOLD is pushed.

TRIGGERING (for Transient Hold or Time Averaging)

Source: From the input signal or from external trigger.

Level: Adjustable -1/2, -1/4, +1/4, +1/2 of full scale of the signal input (does not apply to an external trigger).

TRACKING

External sampling sync at 2.56 times the highest frequency desired provides spectrum frequency coverage that varies with external sampling rate; external sampling sync at 2.56 x N/revolution of a machine under test provides a constant display of N-orders regardless of speed.

PHYSICAL

Size: 8-1/2 inches (21.6 cm) wide
12-1/8 inches (30.8 cm) high (12-17/32 inches (31.8 cm) overall including feet)
21-3/4 inches (55.25 cm) deep (23-1/4 inches (59 cm) overall including front and rear covers)

Weight: 35 lbs. (15.9 kgm) max.

Power: 100, 110 or 220V +10% (specified at time of order), 50/60 Hz, 200W max.

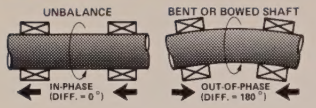
Optional accessories

Model 132A Hard Copy Unit
Model 24C Spectrum Tracking Adapter
Model 24C-07 Spectrum Tracking Adapter with auto-filtering
Model 52 Hammer Kit (for transient triggering)
Model 53A Accelerometer, rugged industrial (power from rear ICP input)
Model 54A Accelerometer, light weight (power from rear ICP input)
Model 55A Velocity Transducer
Model 56A Conversion Unit (acceleration and velocity output from accelerometer)
Model 57A Magnetic Sensor (1/revolution trigger)
Model 99Q Transit Case, Analyzer
Model 99R Transit Case, Hard Copy Unit

PHASE... the 3rd dimension in machine diagnostics

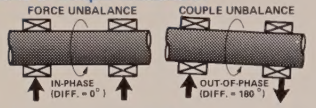
Phase, the relative time between vibration at the same frequency, reveals if two parts of a machine are vibrating together (in phase-0°) or in opposite directions (out of phase-180°) in any one instant. Phase information is necessary to distinguish between the following possible faults, since both appear in the frequency spectrum as increased amplitude at the same frequency.

unbalance, bent shaft or misalignment?



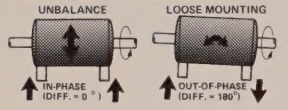
If measurements are made axially at two bearings at opposite ends of a bent or bowed shaft or on two coupled shafts misaligned, the phase at the running speed (1x) frequency will be approximately 180° different. If the machine is merely unbalanced, the phase difference will be 0°.

force or couple unbalance?



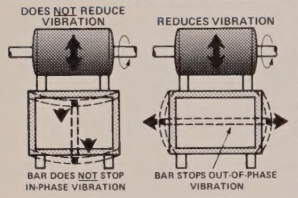
If measurements are made radially at the opposite ends of an unbalanced shaft, force unbalance will show little or no phase difference, whereas couple unbalance will show significant phase difference.

loose support or unbalance?



Measurements made at two loose supports for a machine will be out of phase at a frequency twice the running speed (2x) if both supports are loose and at 1x if only one is loose. For machine unbalance, phase difference will be small at 1x and 2x.

how to reduce structural vibration?



For a structure which vibrates too much, the location of a strengthening member should be between points in the structure which move in **opposite** directions (180° out of phase) rather than in the same direction (0° phase difference). Vibration induced by a rotating machine mounted on the structure can be referenced to the shaft. For impulse testing, the reference is the start of the impulse. (This is equivalent to a simple "mode shape analysis".)

TIME SCAN... to completely analyze dynamic signals

Data held in the 10K input time memory can be scanned using the cursor to select any 1K portion to be transformed to frequency. In this way signals which change in time...machine run-up, speech, reverberations, transients, doppler...can be analyzed completely moment by moment. This provides "real time" 100% analysis to 20kHz for the 10K data block. A dual display presents time and frequency simultaneously to aid understanding.

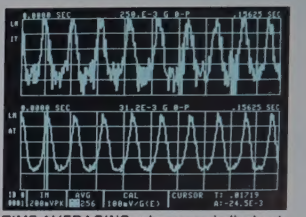
Also using time scan, a 1K time block with a chosen delay from the triggering of the 10K memory can be time averaged prior to frequency analysis. For example, the firing and jitter of cylinder #3 of a reciprocating engine can be measured and spectrum analyzed while triggering from #1.

NICOLET SCIENTIFIC CORPORATION
A NICOLET INSTRUMENT SUBSIDIARY
245 Livingston Street
Northvale, New Jersey 07647, USA
(201) 767-7100 / TWX: 710 991 9619

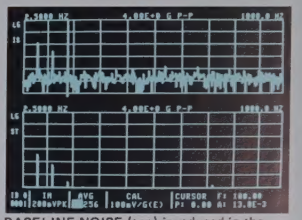
AUG. 1981

Specification subject to change without notice

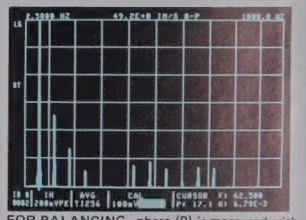
"A good picture is worth 1000 words."



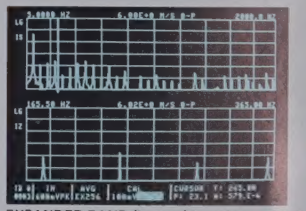
TIME AVERAGING enhances periodic signals synchronized with rotation (instant time-top, averaged time-bottom).



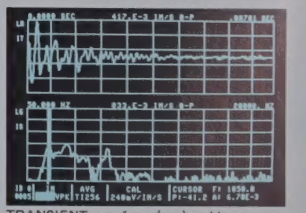
BASELINE NOISE (top) is reduced in the spectrum of averaged time (bottom).



FOR BALANCING, phase (P) is measured with the cursor on the shaft rotation speed peak.



EXPANDED BAND (bottom) is positioned by the cursor on baseband spectrum (top) to reveal detail.



TRANSIENT waveform (top) and its spectrum (bottom) are viewed simultaneously.